RUGBY SCHOOL
NATURAL HISTORY SOCIETY.

1873.

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RUGBY.

REPORT

OF

THE RUGBY SCHOOL NATURAL HISTORY SOCIETY

FOR THE YEAR

1873.

"IIS QUIBUS NON CONJICERE ET HARIOLARI SED INVENIRE ET SCIRE PROPOSITUM EST, OMNIA A REBUS IPSIS PETENDA SUNT."

—BACON.

RUGBY: W. BILLINGTON.
1874.

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PREFACE.

We are seven years old, and with advancing years come the sense of increasing responsibilities, and the necessity for increased exertions. With the constant influx of new blood, we need not fear that we shall lose the elasticity of youth: but when a Society has once become an established institution in a School, the Members are inclined to believe it runs along with no friction, and requires no fresh impulse of any sort from them. Let the Editors, and especially the dying President, assure them that this is a mistake. Whatever other discoveries the Society may have made, it has not yet discovered the secret of perpetual motion.

There is no need however to be gloomy, or despairing: in taking leave of a Society which he has watched with increasing affection for so many years, the President feels no doubt of its continued success. At no time in its history does it seem to him that there were more promising workmen in it, or better work cut out for them to do. Witness, for one thing, the vigorous way in which within the last few weeks volunteers have come forward to take a share in the *magnum opus* of a Geological model of the Rugby district.

The Observatory Report again shows work, and work in which our younger heads have taken their share. Let us call the attention of the School to the invitation printed below to all who care about it to avail themselves of the Temple Telescope.*

Our Botanical Report is conspicuous by its absence; it has been crowded out by other things, but, if possible, it will make its appearance later in the form of a revised flora of the district.

The Reports of the other Sections are rendered rather meagre by the absence of Mr. Sidgwick from England, and by the loss which the leaving of C. M. Chadwick has been to the progress of our Zoological collection.

Our Minutes will show that an increasing number of Papers have been read during the year by the Members themselves, while we have had the good fortune to secure the kind help of three older hands, Mr. R. Scott, Dr. Oldham, and Mr. Whitaker.

* Mr. Wilson and Mr. Seabroke will be glad to see any Member of the School at the Observatory on fine nights from 9.15—10.30 P.M. Not more than 3 should come from any House on the same night.

In concluding our preface, we may perhaps be allowed to say one word of respect to the memory of Mr. Billington, who, at all times a good friend to the School, has been more especially *our* friend by generously publishing our Report for several years.

F. E. Kitchener, President.
L. Maxwell, }
H. N. Hutchinson, } Editors.

Easter, 1874.

NATURAL HISTORY SOCIETY'S ACCOUNTS FOR 1873.

		£.	s.	d.
Receipts.				
By balance (see last Report)		8	5	1
Compositions		11	10	0
Subscriptions, Lent Term,	£2 15 0			
Ditto, Trinity Term,	2 7 6	6	17	6
Ditto, Advent Term,	1 15 0			
Sale of old Reports		0	7	0
		£26	19	7
Expenses.				
Egg Cabinet (repaired)		0	17	6
Wright's bill (Cabinet for Reptiles)		2	11	6
Books and Periodicals		2	8	5
Prizes		2	2	0
Reports distributed to the Society, etc.		4	12	0
Cost of Anastatic Drawings		3	7	6
Bottles and Spirits of Wine		1	19	1
Men for Mr. Scott's Lecture		0	4	6
Cost of gas for Mr. Smith's Lecture		0	7	6
Postage and Carriage		0	4	9
		£18	14	9
To Balance in President's hands		8	4	10
		£26	19	7

RULES.

I.

That this Society be called "THE RUGBY SCHOOL NATURAL HISTORY SOCIETY."

II.

That the Society consist of Honorary Members, Corresponding Members, Members, and Associates.

III.

That Masters, and others connected with the School, be eligible as Honorary, and Old Rugbeians as Corresponding Members; that Present Rugbeians be eligible as Members, or Associates.

Of Officers:

IV.

That the Society's Officers consist of a President, Secretary, and Curator, and of the Keepers of the several Albums, and that these do form the Committee of Management, three to be a quorum.

V.

That all Officers be elected annually.

VI.

That when any office is vacant, the Committee do recommend a Member or Associate, or (for the office of President) an Honorary Member, for election by the Members of the Society, and that the election be by scrutiny.

VII.

That the President take the chair at all Meetings, but have no vote except in cases of equality.

VIII.

That the Secretary keep the Minutes of the Society's proceedings; keep a list of the existing Society, with the names and addresses, as far as possible, of all Corresponding Members, and a list of all Benefactors of the Society.

IX.

That the President and Curator form a Sub-Committee, for managing the finances and keeping the property of the Society.

X.

That the duty of the several Album Keepers be to call together Sectional Meetings; to receive all notices connected with their several Sections; to enter all occurrences of interest in their Album; and at the end

of each year to furnish a Report of what has been done in their Section during the year.

XI.

That in the absence of any Officer, the Committee appoint a Deputy.

Of Honorary and Corresponding Members:

XII.

That Honorary Members be elected by open vote of the Society; pay an entrance fee of 10s., but no subscription unless specially called upon; and have all the privileges of Members, except that of voting.

XIII.

That Corresponding Members be elected by open vote of the Society, without entrance fee, and have all the privileges of Members, except that of voting; but do not receive the Society's Reports without payment, for a supply of which they may pay a composition.

Of Members and Associates:

XIV.

That Members and Associates be proposed by a Member or Honorary Member, and elected by the Committee.

XV.

That the number of Members be limited to fifteen.

XVI.

That no one become a Member or Associate without either paying a composition of 10s., or bringing a note to the President signed by his Tutor to allow a charge of 2s. 6d. per Term to be made in his bill.

XVII.

That Members may speak at all Meetings of the Society; may read Papers with the leave of the President; may introduce four Visitors at all Public* Meetings, and receive a copy of the Society's Report.

XVIII.

That Associates have the same privileges as Members, except the right of voting at Private Business Meetings.

XIX.

That any Member who in the course of the year shall not have read a Paper before the Society, shall require re-election by the Committee.

XX.

That any Member or Associate may be suspended or expelled from the Society by a vote of two-thirds of the Members present, if he, from any misdemeanour, or want of energy, appear to deserve such suspension or expulsion: but such a motion cannot be proposed again during the

* It having appeared that Members and Associates have introduced other persons not belonging to the Society into the Society's room, it is necessary to state that this practice is not permitted by the rules.

same Term after it has once been voted upon in a Meeting at which four-fifths of the Members then in residence have been present.

Of Meetings:

XXI.

That Ordinary Meetings be held once a fortnight, but that the Secretary be empowered to call Extraordinary Meetings when necessary.

XXII.

That Visitors may speak and read Papers at all Public Meetings, with the leave of the President.

Of Reports:

XXIII.

That a Report be printed once a year, or oftener if the Committee think fit.

XXIV.

That an Editing Committee, of two Members and one Honorary Member, be appointed by the President for each Report.

Of New Rules:

XXV.

That, without notice given at the preceding Meeting, no change can be voted in these Rules, or any vote of Suspension or Expulsion passed.

XXVI.

That no change be made in these Rules, unless proposed by a Member or Honorary Member, and carried by the votes of two-thirds of the Members present.

XXVII.

That in all cases where one vote be wanting to make up a majority of two-thirds of the Members present, the President be allowed to vote.

LIST OF THE SOCIETY, LENT TERM, 1874.

Officers:

President: Mr. F. E. Kitchener, F.L.S.
Secretary: H. N. Hutchinson
Curator: F. W. Dutton
Editors: The President, L. Maxwell, H. N. Hutchinson
Album Keepers: Botanical, E. T. Wise
" " Geological, L. Maxwell
" " Entomological, H. Vicars
" " Zoological, B. R. Wise
Entomological Curator: Mr. A. Sidgwick

Honorary Members:

Rev. Dr. Hayman
Rev. T. N. Hutchinson, F.C.S.
Mr. J. M. Wilson, F.G.S., F.R.A.S.
Rev. C. Elsee
Rev. C. E. Moberly
Mr. C. Dukes, B. Sc.
Mr. Percy Smith, F.C.S.

Corresponding Members:

Lord Bishop of Exeter
G. F. Helm, M.D.
E. P. Knubley, 68
W. C. Marshall
W. C. Eyton, 68
T. G. B. Lloyd, F.G.S., 68
J. R. Dakyns, H. M. Geological Survey
C. L. Rothera, B. Sc. 68
F. W. Fison, F.C.S.
C. S. Taylor
E. Cleminshaw
G. B. Longstaff, F.C.S., 68
J. S. Masterman
H. C. L. Reader
F. C. Selous
J. H. Davies, 69
R. E. Baynes
F. R. Smith
E. W. Prevost, D. Ph., F.C.S.
J. M. Lester
H. N. Larden
H. W. Eve, F.C.S., 69
N. Masterman
F. Bayard
S. Haslam
J. S. Alexander, H. M. Indian Geol. Survey
B. E. Hammond
G. M. Seabroke
Rev. A. Bloxam
F. C. Bayard
Rev. J. Robertson
R. Farquharson, M.D.
G. H. Morrell
C. T. Clough
C. Hinton
E. Burchardt
A. S. Napier
R. H. Ker
A. G. Burchardt
R. H. Scott, F.R.S.
W. B. Lowe
Rev. C. J. E. Smith
F. Spurling

A date after the name denotes that the Member has paid a composition for six years' Reports, beginning from that year. We have omitted from this list the names of those who left the School before the passing of Rule xiii, and have never since leaving made any communication to the Society. Any of these, who wish to have their names replaced on the list should communicate with the President.

Members:

E. T. Wise
B. R. Wise
H. N. Hutchinson
L. Maxwell
F. W. Dutton
H. Vicars
G. L. King
H. W. Trott
A. J. Solly
L. Knowles
V. H. Veley

Associates:

H. W. Scholfield
W. H. Cross
S. Bolton
J. W. Johnson
W. A. Sparrow
J. Y. Bostock
H. B. Hemming
W. H. Prichard
T. B. Eden
J. R. Hutchinson
T. F. Johnson
L. Parry
J. O. Beuttler
A. Henderson
W. W. K. Clarke
G. J. Foster
C. H. Sargant
J. N. Stolterfoht
A. Duff
S. Crosse
G. De S. Hamilton
A. Pearson
J. H. Kingdon
A. Ward
H. F. Newall
M. V. Hilton
W. J. Napier
R. Cunliffe
L. McMahon
E. Inglis
S. King
W. S. Benyon-Winsor
W. Abraham
G. A. Solly
F. Hutchinson
C. A. James
R. A. Fayrer
H. Hurrell
R. H. B. Bolton
R. D. Oldham
G. Varley
D. P. Kingsford
H. L. Baggallay
C. M. Cunliffe
W. Larden
T. A. Wise
H. T. S. Houghton
W. B. Thornhill
J. Y. Johnson
H. W. Fowler
H. F. Wilson
E. J. Power
H. Willis
M. J. Michael
H. Symonds
H. V. Armour
W. Calvert
H. I. Davis
C. Bayley
W. F. Hawtrey
A. C. Bannister

LIST OF PAPERS.

LIST OF PLATES.

* These are, or were at the time, actual members of the School.

MINUTES OF MEETINGS.

MEETINGS HELD FEB. 1, *MAY* 10, *MAY* 26, 27, *JUNE* 9, *and SEP.* 27, 1873.

At these Meetings only private business was transacted.

MEETING HELD FEB. 8:—*Donation:* Ferns and Woods from Otago, New Zealand, sent by an Old Rugbeian.

Mr. Wilson made some remarks on the Fossil remains of Butterflies from the Lower Oolite, to be seen at the Oxford Museum.

The report of the Temple Observatory and the report of the Meteorological Committee for the past year were then read.

The Rev. T. N. Hutchinson then gave an account of the process of Smelting Copper at Swansea, and exhibited a number of specimens illustrating the various stages of the process.

MEETING HELD MARCH 8:—*Donations:* Diagrams of typical species of Insects and Fishes, by A. J. Harvey, Esq.

Bones and teeth of Hyæna, Elephant, Lion, Rhinoceros, Deer, etc., together with flint instruments, from a cave near

Haverfordwest, by J. R. Allen (O. R.); Collection of Fossils from the Menevian and Cambrian rocks, near St. David's, by the same.

Exhibitions: Ammonites Bucklandi, by F. Arnold. Case of Jewels and precious stones, cut and uncut, in various stages, by Rev. T. N. Hutchinson.

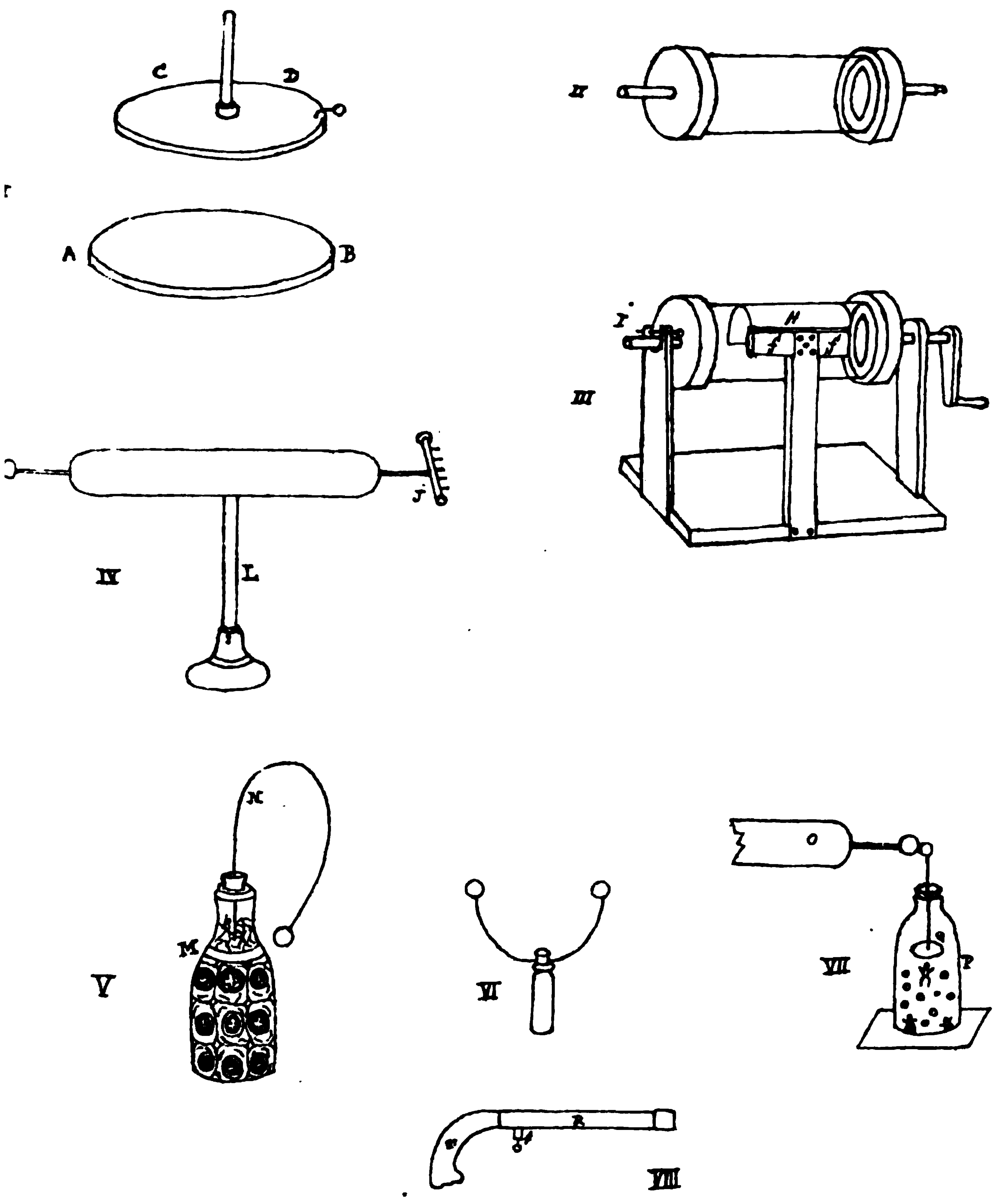
H. N. Hutchinson (member) then read a Paper on '*Home-made Electrical Apparatus.*' The object of the Paper was to show how cheaply electrical apparatus can be made, and was illustrated by experiments performed with the home-made apparatus described in the Paper.

The following extracts are taken from the Paper:—

'Descriptions how to make electrical machines may be found in many books, but they frequently require a considerable outlay, both of time and money. The object of the following Paper is to show how an electrical machine and several useful pieces of apparatus may be made at a very small cost and in a simple way, and at the same time such as to give good results. The apparatus described in this Paper was made by my brother and myself four or five years ago. I have only selected a few things out of a great many that we contrived, but it may be sufficient to show how easy it is to make sufficient electrical apparatus for a great number of experiments. I shall only describe how we made an electrophorus, cylinder machine, leyden jars, dischargers, bell jar for pith figures, and electrical pistol. Plate i. contains outline sketches from the things themselves, which I will take in the order just given.

'To begin then with the electrophorus. AB Plate i. is a circular tray made in tin 12 inches in diameter, the rim being ¼ inch high. Into this a mixture of equal parts of Venice turpentine and resin is poured, after being heated in a ladle. It should then be placed quite level over a hot stove, in order to let it settle down to a smooth and flat surface. CD is a disc of wood, with rounded edges 10 inches in diameter carefully

Plate I.



covered with tinfoil, leaving no rough points. A glass rod is fixed into this for a handle. In order to get sparks the tray must be warmed and then rubbed briskly with hot flannel (or better, cat's skin). The disc CD is then placed on the surface of the resin and touched with one finger. On removing it, a spark often an inch long may be got from the knob. This may be repeated many times without fresh rubbing.

'ELECTRICAL MACHINE.

'Choose a tall glass jar, such as you see in confectioners' shop-windows. This is to be the cylinder which must be mounted and made to turn in a stand, with a rubber pressing against it. Next get two wooden caps turned to fit on to the ends of the cylinder, about an inch deep, with projecting pivots. The caps are next to be cemented on to the ends of the cylinder. The cement is composed of resin, beeswax, red ochre, and a little plaster of Paris, and must be heated over a slow fire. The open end of the cylinder must be first covered over with a piece of silk to prevent bits falling in. This done, we have what is shewn in Fig. ii.

'The stand in Fig. iii. is made of deal. E is the support of the rubber FF, and is made of thin deal firmly screwed to the stand, so as to press tightly against the cylinder. Some rubbers have a screw at G by which to press them more tightly against the cylinder, but the thin support will give pressure enough. On the interior side of FF is a cushion of leather stuffed with horsehair, over which comes a silk flap exactly the same size, which is glued along the bottom of the strip of wood FF. This flap carries the amalgam.

'The amalgam which we have used is made by kneading together tinfoil and mercury, until they become a sort of paste. The silk flap on the rubber must be slightly greased with tallow, and then just as much amalgam spread on as will adhere. This will give a greatly increased effect to the machine. Behind the silk flap just described is glued, in the same way, another and larger one, H, coming half-way down the other side of the cylinder. This flap is glued on first, and then the other over it. The handle may be made of strong

wood, with a square hole fitting on to the end of the pivot. To amalgamate the rubber the cylinder must be taken out by removing the pin I and the handle.

'This done, warm the machine, and then turn it in the dark, and you will see flashes of light on the glass, and light bodies will be attracted to it. Thus with this much of a machine we get some electrical effects, but we want something which we can charge with electricity—in fact, we want a conductor.

'THE CONDUCTOR.

'In all bought machines this is made of brass or tin, but an equally good one may be made by getting the same shape turned in deal wood, and covering it very smoothly with tinfoil. The one in Fig. iv. is made in this way, the wooden part being 10½ inches long, and rather more than 2 inches in diameter. The fork J may be turned in wood without the points, covered with tinfoil, and then pins put through from the back. The balls at each end prevent loss of electricity. A thick brass wire joins this to the wooden part. From the other end comes a similar wire, to the end of which is fastened a wooden ball covered with tinfoil. L is a thick glass rod (varnished with sealing wax, or shellac dissolved in spirits of wine, to keep off damp), which is fastened into a wooden stand. It is best to have a large conductor. The first conductor we made was not nearly as large as our present one, and consequently did not give such good results.

'LEYDEN JARS.

'A very good Leyden jar may be made with an ordinary plum jar, by lining it with tinfoil inside and outside nearly up to the top, and plugging the mouth with wood. Through this wood comes a thick wire, from the bottom of which hangs a chain touching the inside of the jar. The top of the wire has in most cases a brass ball. But an oak-ball covered with tinfoil makes a very good substitute. The covering must be quite smooth. This will be hard to do at first, and will require practice. The points should be rubbed down with the finger nails. It is worth while to get a good many round oak-balls and cover them with tinfoil, as they will be found very useful.

'To line the inside of a jar is a difficult thing and cannot be done when the jar has only a small mouth, since the tinfoil must be smoothened by putting one's hand inside. Instead of this we may drop sheets of Dutch foil one upon the other inside the jar, so as to nearly fill it up. (Dutch foil is something like gold leaf, and may be got at 2d. per book at the chemists.)

'The jar in Fig. v. is called a "spangle jar." The inside is filled as just mentioned, but the outside coating instead of being tinfoil consists of fancy paper, with a pattern either in gold or silver. Round the top of the paper at M is pasted a strip of tinfoil. The wire N is bent so as nearly to touch this band. Thus when the jar is sufficiently charged a flash goes from the knob at the end of the wire (which is an oak-ball, covered with tinfoil) to this tinfoil band, and from thence spreads itself all over the gilt part of the pattern, producing in the dark a very pretty effect. The jar used in this case is an old pickle bottle, as perhaps Fig. v. may suggest, and answers very well.

'I may here mention that by passing sparks from the conductor on to the gilt edges of a book, or the pattern outside, or any metallic pattern, very pretty effects may be obtained. Endless modifications of these may be made, as a strip of glass with round bits of tinfoil gummed on in any pattern, near each other. The sparks may be coloured by placing over the glass bits of gelatine taken off "crackers."

'DISCHARGING RODS.

'Choose a rather thin and long bottle, one that will form a nice handle. Put a hard cork into its mouth, and through it put a copper wire bent into a half circle. This wire must be tightly fastened with thin wire to the cork, to prevent its slipping. On to the ends of the wire are put oak-balls covered with tinfoil. The wire being copper will bend to suit any sized jar.

'Fig. vi. represents a pair thus made, which answered very well.

'BELL JAR FOR PITH FIGURES, ETC.

'The object of this piece of apparatus is to show the attraction and repulsion of light bodies when electrified. Pith figures made slightly heavier at the bottom dance in a very amusing and grotesque way. The pith from the stems of old artichoke plants will be found very good for this purpose and easy to get. It should be warmed till quite dry and then cut out with a very sharp penknife. The several parts of the figures may be gummed together. Pith balls should also be made for this experiment and for numerous other pieces of apparatus. In Fig. vii. O is the end of the conductor. The bell jar P is one of the glass shades used for candlesticks, inverted. The top is closed with a cork, through which runs a wire terminating in one of our tinfoiled oak-balls. To the other end is fastened a circular disc of cardboard covered with tinfoil, a pith ball covering the extreme point to prevent loss of electricity. Thus the disc Q can be raised or lowered. The glass must be thoroughly warmed and then placed on a sheet of tinfoil, having on it the pith figures, &c., which are to dance. On placing the knob in contact with that on the conductor and working the machine the figures will dance vigorously.

'THE ELECTRICAL PISTOL.

'The object of the electrical pistol is to show the power of an electric spark to explode a mixture of oxygen and hydrogen in the proportion 1 to 2 volumes.

'R (Fig. viii.) is a tin tube fitting on to the handle T, which is the end of an old walking-stick. S is a glass tube going through a hole in the tin barrel, and through it runs a wire, the outside end of which terminates in a small lead bullet. The other end reaches to within $\frac{1}{8}$ of an inch of the inside of the tin barrel, and must not be pointed. The experiment is performed thus. Fill the barrel with the mixture of oxygen and hydrogen and cork it up tightly, then pass sparks from the conductor to the lead bullet. These sparks will be reproduced at the end of the wire inside the barrel and go to the tin, and the gases will explode, blowing out the cork to a considerable distance.

'We have often done this with a mixture of coal-gas and air, by holding the tube downwards over a gas burner, and allowing it to be partly filled with gas. Several, and sometimes many, tries are required before success comes, but we have often by practice made it go off several times in succession.'

MEETING HELD APRIL 8:—*Donations:* Corals from the Carboniferous Limestone, by Mr. S. G. Perceval: Minerals from Devon and Somerset, by Mr. R. Wheeler.

The following Paper, by C. M. Kerr (present Rugbeian), was then communicated by Mr. Wilson:—

'AN EXCURSION OF MR. WILSON'S GEOLOGICAL CLASS TO MOUNT SORREL.

'Mount Sorrel is situated about 8 miles N. W. of Leicester, and consists of granite, or more strictly speaking syenite. On approaching the S. W. side there is a section exposed, close to the church, shewing the joints admirably. On ascending the hill on that side, about 100 yards east of the church, the granite is again exposed and shews glacial markings, ranging generally E. and W. We examined the surface soil, wherever exposed, for drift; and all the way up the sides, as well as on the very top, small glacial flints were to be found. The rest of the soil was wholly composed of disintegrated syenite. It is striking that this atmospheric soil, as it may be called, should be so thick; it proves that the surface of the syenite is being broken up by atmospheric agency; and it plainly divides into sand, grains of quartz, and felspathic soil. Specimens of syenite in all stages of disintegration were easily found in an excavation about 8 feet deep near the windmill.

'To the N. a section has been recently exposed consisting of the red marl which surrounds Mount Sorrel, lying on an incline away from the hill, and above it a layer, about 2 feet thick, of glacial drift, containing abundant chalk pebbles well striated. The matrix is a sticky brown clay, very closely resembling the glacial drift in the Rugby Pit, and elsewhere

in our neighbourhood. There is also, a little further east, another drift, consisting of a reformation of red sandstone, passing into a reformation of lias: it contained pebbles, nodules, and fossils of various ages, some of them striated. Opposite this section is a slope of syenite from which the surface soil has been removed, shewing fresh striation, and all rounded and moulded by ice.

'While we were there the workmen were preparing to blast a portion of this cliff: a hole having been drilled, 35lbs. of powder were put in. We retired to a sufficiently safe distance, and watched the result. The fuse was lighted, and after a lapse of 3½ minutes the whole mass was thrown in huge blocks to the bottom of the slope.

'After this we went into the quarry, and examined the machines for breaking up granite. Two great jaws consisting of iron blocks, grooved downwards, and nearer together at the base than at the top, received the blocks of granite as they were shovelled in and crushed them. The wear of these jaws is so great that they only last about a fortnight: all the while the machinery keeps up a deafening roar. The blocks of granite after the pounding fall into a long cylinder, revolving on an oblique axis, with small holes at the top through which the dust falls, then holes a little larger for the pebbles for gravel walks, then holes larger still for the stones for road mending. These fall through the revolving sieve into trucks in which they are borne to their various destinations. The whole of the machine house and the machinery is covered by a thick layer of fine white dust, which would perhaps make very good material for pottery and china. All blocks required of a particular form, for curb stones, paving, &c., are cut by hand.

'Mr. Hamblyn, the manager of the works, then took us all on an engine, and we ran down the straight private line to Barrow, standing about all over the engine, and holding on as best we could. There we examined a cutting in the lias, just at its base above the Rhætic beds. On the line we noticed a block of slate such as is found at Swithland. We also, on our return, stopped our engine in order to go and examine a limestone quarry. The partings between the beds of

limestone consist of beds of the most finely laminated shale.

'We then whizzed up the line to the granite quarry once more, and examined the junction of the red sandstone and the syenite. It was very well exposed: the red sandstone rests on the granite, its dip being steeper nearer the hill, while amongst it were occasional water-worn boulders of granite, round which the sandstone was deposited when Mount Sorrel was an island.

'In the face of the cliff below the windmill is what appears to be a vein, or it might be an interstratified mass, of a bluish syenite, more like basalt, which is used for the same purposes as the granite, and is preferred by some persons. It seemed to dip W. N. W. at a high angle, and in some parts was sharply defined; but elsewhere not so. One great mass we saw, by its position part of the vein, but by its structure and colour belonging to the general syenite. Here also were grains of iron pyrites in veins in the syenite.

'Then we went to the Rectory, where we enjoyed a wash and a dinner, thanks to the hospitality of the Rector; and then by our omnibus to Leicester, and thence after spending a very happy day by train to Rugby.

'The thanks of our whole party, 14 in all, are due to Mr. Hamblyn and his foreman, who shewed us everything that could be seen in the time; and especially to Mr. Gillson, of Rugby, son of the Rector, who arranged the whole excursion, and thereby gave us no small pleasure and profit.'

W. B. Lowe (member) then read a Paper on the '*Manufacture of White Lead,*' producing specimens of the pots used and the lead in various stages.

The President then read a Paper lately published by M. H. Bloxam, Esq., on the Bottle found at Lawford, and exhibited last year to the Society.

The President then read a Paper on the '*Geographical Distribution of the Sequoia, or Wellingtonia,*' and gave an account of Professor A. Gray's views on the subject.

MEETING HELD MAY 24:—*Exhibitions:* Stamenless form of Ground Ivy from the Barby Road, by the President; Living Corals, by Rev. T. N. Hutchinson; Two Photographs of Sequoia gigantea, and Collection of Photographs of the Yosemite Valley, California, lent by Mr. Power. *Donation:* Case of Insects from Geneva, by Mr. Melly (O. R.)

G. L. King read a Paper on '*Gun Cotton.*'

Mr. Wilson then read the following Paper on '*The Rugby Drift,*' and exhibited a series of fossils from the L. and N. W. Railway, near the Clifton Road Bridge:—

'On April 10, 1873, and some following days, I visited the cutting of the L. and N. W. Railway between the station and the Clifton Road. Between the two bridges the line was being widened on the east side, so as to admit of a fourth line of rails. The east side was exposed for about 200 yards on both sides of the bridge nearest the station. At the northern end the undisturbed lias clay was exposed to about the depth of 4 feet, and was covered by brown clay and sand containing various water-worn pebbles. At the bridge the surface of the lias is about 2 feet above the line, and it sinks to the level of the line just south of the bridge.

'From this lias I obtained a series of Ammonites, which I exhibit, and which are, I believe, A. Brookii, and A. Birchii.

'The whole face of the cutting is therefore in the drift, and it is on this that a few remarks ought to be made, as it may be long before it is again exposed.

'Immediately resting on the lias is a bed of from 10 to 12 inches of dark brown greasy clay, very full of small chalk pebbles; then came from 3 to 5 feet of brown greasy clay, with very little chalk and no pebbles, or very few; over all was a drier, sandier brown clay with pebbles of the so-called northern drift—*i.e*, of quartzite, containing often pockets or instratified patches of sand finely stratified. In it there are abundantly to be found striated chalk pebbles, and flints, mixed with blocks of red marl and sandstone. At the top of all, but

without any decided line of separation, is the so-called northern drift, consisting of sand and gravel, with abundant flints and quartzite pebbles.

'The examination of this section has suggested to me as probable what has been floating about in my mind for some years as a hypothesis on which to observe these perplexing drifts. A reference to pp. 27—31 of the Society's Report for 1868 will shew how far this hypothesis is a modification of the views I then entertained. It seems possible that what we have been calling the northern drift, and separating from the glacial drift in origin, and in time, and in mode of deposit, may be only a later member of the glacial drift and very intimately connected with it. After the surface of this part of the country had assumed its present general outline of hill and valley, after its drainage system had been established, by the combined action of sea and river and rain, it seems to have began to sink to the sea level once more. The soft clayey shores easily yielded to the waves in the estuaries, and a shore deposit was formed of which the main ingredients were derived from the clays in the immediate vicinity. But the presence of chalk pebbles in this deposit shews that some agency was conveying it hither from the east or north-east. I do not know how far to the west this drift extends. It is found abundantly here just below the crests of the hills, down to perhaps 310 feet above the sea. It certainly extends northward as far as Mount Sorrel, for our geological excursionists saw it exposed on the northern flank of Mount Sorrel to great perfection last Term, and it was precisely like what we are here so familiar with. I conceive this to have been effected by floating ice of no great mass. The perplexity to me is that we are on the west of the watershed, and I see no gap through which the floating ice would readily pass. Some such gap may then have existed and now be stopped up by drift, and there are other circumstances which render this a not unlikely solution of the difficulty. As the land sank further it ceased to supply so exclusively the materials for the deposits that covered it. Hence the clays that rest on these blue drift clays are more varied and generally brown. They contain admixtures of

sand, and sometimes the sand is very pure. These brown clays and this sand seems very plainly derived from the trias marls and sandstones which lie north and north-west of us. The direction of the drift then must have been shifted a few points, or gone round from N. E. to N. or thereabouts. Still, however, chalk blocks are found in this, and large oolitic blocks and pieces of upper lias, mixed with blocks of sandstone of triassic origin. All this indicates an origin N. N. E. of Rugby, from which alone this mixture could be obtained. Here too we begin to find the well-worn and extremely hard pebbles of quartzite, varying from almost transparent quartz to dark liver colour crystalline quartzite, which is, in fact, a metamorphosed grit. And higher up we find these and the flints mixed together in varying proportions, and forming what is called the northern drift. This seems to me now to be only another stage of the glacial drift. The country had sunk still further, and stones, which now floated over it on ice, or were drifted by currents, were brought from greater distances; and these water-worn pebbles were derived from the lower trias or bunter beds, somewhere to the north of us at a considerable distance. In these bunter beds is a deposit of loose conglomerate of such pebbles, so that the rolling and rounding of them must be referred not to the glacial age but to one far preceding it, dating back to the beginning of the secondary age. They are an old shore deposit, a pebbly beach of triassic age, never completely compacted, and now dispersed over this part of the country in the gravel. The character of the pebbles generally confirms this view, and this general view seems to me to explain many things which have been perplexing:—these vast accumulations of drift sand at Hillmorton, at Harborough, in Rugby, and elsewhere. It seemed impossible to assign them a place in the series; they graduate, in fact, without a break into the pebble drift above, and the chalk and lias drift below.

'There seem to me therefore now some grounds for believing that our general drift here is not divisible at all, but is the result of one continuous process performed while the land was sinking, the materials at first being derived from the imme-

diate neighbourhood, and afterwards from greater and greater distances. The sands would be separated from the rest by the action of the currents, and it is to them we must look for the cause of such deposits of sand and clay as are mentioned above.*

'I have stated the hypothesis that these water-worn pebbles are the remains of the bunter conglomerate. But I am not acquainted with this conglomerate *in situ*, and know of it only from books; and it is fair to mention one or two facts that conflict with this. The stones that form it may, to a considerable extent, have come from the eastern side of the Warwickshire coal-field about Hartshill, the character of the stones being not at all dissimilar, and they may therefore come hither not ice-borne but simply rolled. The great mass of stones that form the drift at Hartshill are plainly derived from the immediate neighbourhood, and are not rolled but angular and imbedded in triassic sand. It requires further examination to ascertain how far these angular and rounded stones graduate into one another. The effect of this modification of my view is not great; it only has the effect of deriving the pebbles from a nearer source still than the one assigned above.

'Some members of the Society have asked me what they can do by way of useful study and work in the drifts. I will suggest one or two things that only require a moderate knowledge of rocks, and some patience. (1) To observe and give *written* descriptions of the drift wherever exposed, describing the amounts of sand, of clay, of rolled and angular stones, with any remarks on the striation of the stones or the absence of it, and on their origin. (2) In the gravel to compute a few percentages of flint and quartzite, as to number, and approximately as to bulk, taking care to select average localities in each pit. (3) To extend their observations, as far as time and legs will carry them, into the neighbourhood of Rugby.'

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* The oolite drift of Brownsover is certainly perplexing: I have already described it to the Society; and all that can be said of it here is that it underlies the pebble drift, and seems, therefore, to correspond to the middle portion of the general drift. It is not exposed anywhere to its base, and not sufficiently known as to its extent to enable me to speak positively about it.

MEETING HELD JUNE 7:—*Donation:* Collection of Economic Plants, by Rev. A. Bloxam. ***Exhibitions:*** Vertebræ of large Icthyosaurus, from Victoria Lime Works; Upper Lias Shells, from Drift of Mount Sorrel, by Mr. Wilson; Ammonites Conybeari, by F. Arnold; Primrose, shewing two storeys of peduncles, by the President; Mamestra Persicariæ, bred in 1873, by Mr. S. Haslam; Grass growing through a Stick, by H. W. Trott.

H. W. Trott then read an '*Account of an Expedition of the Botanical Section to Princethorpe.*'

'On Monday, May the 19th, the Botanical Section had an expedition to Princethorpe—a village on the red sandstone beyond Frankton, about 7 miles distant. On arriving at the Princethorpe Wood we found the Orobus tuberosus (a Pea-flower not to be found within the five-mile radius) and several Grasses and Sedges, amongst which were Melica uniflora and Carex sylvatica; and lastly, the great Starwort (Stellaria holostea), a few specimens of which were found to be attacked by the fungus, Ustilago antherarum, so called because it is found on the *anthers* of certain flowers. Leaving Princethorpe Wood behind us, we set out on our return to Rugby. We did not forget to pay a short visit to Frankton Wood, but did not expect to find it so destitute of flowers as it then was; though no doubt later in the season it will reward the botanist for his trouble. Having passed through the wood, we found the Helmet Orchis in bud, and close by the leaf of the Adder's-tongue Fern just appearing above the ground. We then continued our walk, arriving at Rugby about 7.30.

'The variety of fungus which I mentioned above (the Ustilago antherarum) attacks the Silene and red and white Lychnis as well as the Starwort, all of which belong to the Pink family. The different varieties of Ustilago attack chiefly the Grasses, Sedges, and Pinks. The spores (or reproductive cells) of the Ustilago are simple, springing from delicate threads, or produced in the form of closely-packed cells, which ultimately

break up into a black powdery mass, as is the case here. This fungus is much the same in appearance as the mildew of wheat or Puccinia graminis, though it differs somewhat from it in form.'

W. B. Lowe then read the following Paper on '*Cohesion of Water at various Temperatures.*'

'The following experiments were suggested by a remark made in one of Mr. Wilson's lectures on heat on the continuity of the states of matter. It occurred to us to examine whether the degree of fluidity of water varied at different temperatures, and we intended to try it especially at temperatures very near 0°C. These experiments were, however, unavoidably interrupted, and we are obliged to offer them in an unfinished condition to the Society. They cannot be resumed, as their value depends on the identity of the apparatus used throughout.

'Our method was to allow water at different temperatures to drop slowly from a pipette with a glass stopper, and to count the number of drops that went to 100c.c. The following table of results obtained by W. B. Lowe will be intelligible at a glance.

'It must be admitted that some precautions were not adopted that must be observed in repeating these experiments, if any one should think it worth while; we did not observe them, as we regarded them as preliminary only. It is plain that the temperature of the air, the degree of moisture of the air, and the pressure of the barometer, ought to have been observed in order to make the results accurate.

'But it is probable that the corrections which would follow from these observations, even if they could be computed, would not affect the general result, which is, that *the magnitude of a drop, ceteris paribus, steadily diminishes as the temperature rises.*

Volume in c.c. of 100 Drops of Water at Different Temperatures between 40°F and 150°F.

Number of Drops.		Vol. in c.c.		Temperature.
100	=	4.62	at	41°F
100	=	4.62	„	42°

Number of Drops.		Vol. in c.c.		Temperature.
100	=	4.62	at	44°F
100	=	4.69	„	41°
100	=	4.62	„	45°
100	=	4.62	„	43°
100	=	4.627	„	42°
100	=	4.62	„	42°

And the Average of these 8 *Experiments gives*

100	=	4.629	at	42°5F

100	=	4.606	at	50°F
100	=	4.613	„	51°
100	=	4.55	„	50°
100	=	4.55	„	52°
100	=	4.55	„	52°
100	=	4.606	„	50°
100	=	4.62	„	50°
100	=	4.606	„	50°
100	=	4.606	„	50°
100	=	4.606	„	50°
∴100	=	4.5913	at	50°.5F

100	=	4.55	at	60°F
100	=	4.62	„	60°
100	=	4.55	„	60°
100	=	4.536	„	60°
100	=	4.62	„	60°
100	=	4.62	„	60°
100	=	4.55	„	60°
∴100	=	4.578	at	60°F

100	=	4.48	at	80°F
100	=	4.473	„	85°
100	=	4.494	„	82°
100	=	4.41	„	80°
100	=	4.48	„	80°
∴100	=	4.4674	at	81°.4F

Number of Drops.		Vol. in c.c.		Temperature
100	=	4.41	at	100°F
100	=	4.41	,,	100°
100	=	4.41	,,	100°
100	=	4.396	,,	100°
100	=	4.34	,,	100°
100	=	4.34	,,	100°
100	=	4.41	,,	100°
100	=	4.41	,,	100°
∴100	=	4.3908	at	100°F
100	=	4.41	at	120°F
100	=	4.41	,,	120°
100	=	4.382	,,	120°
100	=	4.396	,,	120°
100	=	4.347	,,	120°
100	=	4.34	,,	120°
100	=	4.396	,,	120°
∴100	=	4.383	at	120°F
100	=	4.34	at	130°F
100	=	4.347	,,	130°
100	=	4.357	,,	130°
100	=	4.396	,,	130°
100	=	4.34	,,	130°
100	=	4.284	,,	130°
∴100	=	4.3425	at	130°F
100	=	4.284	at	140°F
100	=	4.326	,,	140°
100	=	4.34	,,	140°
100	=	4.284	,,	140°
∴100	=	4.3085	at	140°F

The President then explained a chart of flowering dates for 1872, as compared with temperature and rainfall.

B. R. Wise (member) read a Paper on the '*Australian*

Fauna,' describing the Dingo, the Bat, the Opossum, the Flying Squirrel, and the Flying Mouse.

MEETING HELD JUNE 21 :—*Donations:* Boar's Teeth from India, by R. D. Oldham; Orobanche minor (new to the Flora), by Rev. A. Bloxam. *Exhibitions:* Series of the rarer Kentish Orchids, from Dorking, and Tubers of Figwort Buttercup growing in the axils of leaves, by the President; Pelorian forms of Calceolaria, by L. Knowles.

The Rev. C. J. E. Smith (hon. member) read the following Paper on a '*Foxglove,*' then in flower in his garden.

'ABNORMAL FLOWER OF FOXGLOVE.

'The flowers of Foxglove are generally developed laterally upon the tall stem of the plant, each flower-stalk growing in the axil of a leaf, but bending across the stem so as to hang upon the side opposite the leaf; that which is, botanically speaking, the uppermost petal, becoming thereby the lowest in position (as happens in Orchids), and affording a convenient landing for the humble-bees which revel in this flower. The inflorescence is *indeterminate,* and there is no terminal bud whatever.

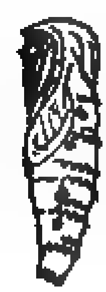
'About a fortnight ago, however, I observed a terminal bud beginning to develope at what would generally be about half the natural height of the stem. It was then unopened, but it was easy to see three or four petaloid leaves amidst a thick mass of small ordinary leaves, which played the part of a very irregular calyx or involucre to the flower.

'There were 13 stamens and a large ovary formed of several coarse carpellary leaves, each with a thick style, the whole having the appearance of a bottle standing up in the centre of the flower. Not knowing how far it might get developed I got a photograph taken of it (this was kindly done by H. N. Hutchinson). See Fig. i., Plate II. A few days after a second photograph was taken, the flower having opened

Plate II.

Fig 1.

Fig 2.



Real size of pupa.

a good deal more; and to-day a third has been taken (see Fig. ii., Plate II). The flower is now fully developed, about 4 inches across; the petals, which are joined together for some distance around the base, lie completely back, spread out as far as they can stretch. They are spotted all over in the way in which the large or uppermost petal in Foxglove usually is; they are in four divisions, each shewing at the end the outline of two or more lobes. The impression given is that of the materials of three or four corollas clubbed together to form one. The 13 stamens point to the same conclusion. To-day the stamens have begun to develope pollen.

'There does not seem to be any prospect of a development of stigmatic surfaces; but as the stigma is the last part of Foxglove to come to maturity, it is worth while to wait some days longer.

'There are about a dozen proper flowers on the same stem below the monster; they are opening in the usual order—namely, the lowest first; but the monster took precedence of all. As the stem is cut short by the abnormal growth at half its usual height, it is natural to expect that the side branches, which spring from near the base of the stem, will grow more than they usually do. There are two such, with some flowers on each, and I suspect that each of them is going to develope a terminal bud similar to the one I have described upon the main stem.

'If so, those who have not yet seen this plant will have an opportunity of seeing the entire growth from beginning to end.'

Mr. Wilson then gave an account of a visit lately made by him to the Clapham Cave, near Ingleborough, and the Weathercote Cave and Victoria Cave, near Settle, Yorkshire, and illustrated his remarks by photographs and specimens.

The following Paper, by E. Mann (present Rugbeian), on a '*Geological Expedition to Atherstone and Nuneaton*,' was then read.

'Last Monday, June 9th, Mr. Wilson took several fellows of

his geological set, and of the geological section, on an expedition to visit some quarries and a coal mine, near Atherstone. The party started from Rugby at 2.15 by rail, and arrived at Atherstone about 3 p.m. The town of Atherstone consists of one long street; it is a quaint old place, but has one or two handsome new buildings in it. The first place the party visited was the kennels, where the Atherstone hounds are kept. There are 60 couples of trained dogs there, kept beautifully clean and tidy. They did not stop there long, for geology called them, and there was no time to waste. The next place they visited was a quarry, where the millstone grit is worked. The face of stone visible is about thirty feet high. It dips west at an angle of about 30°. The rock has been highly metamorphosed by greenstone, which is intrusive within the strata. This rock is very largely used for roads. Passing on from here they went along a ridge of hills which rises about 150 feet above the plain, and is caused by a fault which has thrown down the coal on the east. From this ridge, on a fine day, an excellent view is obtained of the country round, even as far as Mount Sorrel. After walking about four miles they came to the Hartshill quarries, which is the only place where the greenstone is visible, in actual contact with the grit, in this neighbourhood. Here was seen to perfection how the greenstone was forced in between the strata, as the rock above was burnt quite black and was exceedingly brittle. It is even more burnt than that below, in some places. A vein of crystallized quartz was here visible running through the rock in one place. From here they walked on to Stockingford, a little village near Nuneaton, where the coal pit they were going to explore was situated. There was some little delay before going down the pit, as the foreman had to be sought and miners' coats had to be fetched. In the meantime one of the party, picking about on the beds of shale, round the pit-mouth, found a piece of sigillaria, the fossilized stem of a tree. These are not very often found here, and so it is worthy of note. One of the colliers said they sometimes found marks, like the print of hobnails, on the coal, which is not a bad description of the sigillaria.

'It was now time to go down the pit, and so the party prepared, by taking off their coats and hats and leaving them above, and as many as could got miners' coats and strong hats to protect the head if it struck the roof. They had to go down in parties, as the cage would not hold them all at once. When they arrived at the bottom of the shaft, at first they could see nothing, but as their eyes got accustomed to the darkness, which was absolute except for the faint glimmer of a few farthing candles, they began to peer about. The first thing that drew their attention was the trucks, which are made up of trays, made by broad iron bands which are moveable, so that when the passages are low some of them can be taken off. Preceded by the foreman, and followed by two other colliers to see that none of the party got lost, they picked their way through passages, which were too low to be at all pleasant to walk in. After scrambling along some distance they came to a place where the roof had fallen in, and was being propped up with wooden posts. A little further on the guide stopped suddenly, and told them he thought he heard the roof coming in a little further on. They stopped to listen, but could not hear anything as the number of the party was too large to get absolute quiet. However it was not thought advisable to go further, so they turned back and went down another passage. Here in one place was a band of clay between the layers of coal. A little further on there was a place at which the floor had been squeezed up to meet the roof. After seeing this they retraced their steps, and went to see the furnace which draws air through the workings where the men are. As there was nothing more to see they went up again, and after a wash, which was much needed, they went to see the place where the coal crops out. They saw one spot where the coal had been actually worked at the surface without any shaft or tunnel. In another place close by there are two tunnels which go into the ground following the strata, but which are now disused. At one of these the coal can be seen quite plainly, dipping at an angle of about 50°. Clay iron ore is worked at the same place, but it is sent away to be smelted. From here they turned their steps to Nuneaton, and arrived

there in good time for a train at 8 p.m., which reached Rugby at about 8.40. The day could not have been more favourable, and I am quite sure that, without exception, all the party enjoyed themselves exceedingly.'

Mr. Sidgwick (hon. member) then read the following '*Experiments on Ants.*'

'In the last few days I have been observing a small colony of ants in my garden.

'They are established under some ivy which abuts on a path, and they have occasion (for social, commercial, or political purposes, I don't know which) to cross this path to the scene of action on the other side. I have not examined where they come from, or where they go to; and the only point I have been observing is their mode of action across the path.

'The first glance would lead one to suppose they are wandering aimlessly: but only the first glance. They never run straight for more than a short way; then comes a slight swerve to the right or left, with much action of the antennae: then another little run, and then another swerve; and so on. It is this constant slight swerving which gives the first air of aimlessness; but a very little watching shews that their swerving is within narrow limits, not more than an inch at most, and rarely so much; and that their general direction is very straight.

'How do they find their way?

'Not by sight, clearly: for they would not have to swerve at all.

'I tried two small experiments to solve this, both with results which were amusing and interesting.

'On Thursday I waited till a part of the track was clear of ants, so that they might not see my manœuvres; and then with a sudden sweep I drew my two fingers across their path, not removing any stones, but only sweeping off particles of dust and grit, and making the road a little rougher, certainly not so as to form any obstacle to an ant.

'Up they come, trotting and swerving at a good pace.

Then the front one reaches the part where my finger had been. Stops dead. Trots off to the right, stops again, trots off to the left, back and forward, round and about: only across those finger-marks he will not go. Meanwhile his antennae are going at a frightful rate. Soon he is joined by another. Same manœuvre. Then another. At last there is a crowd on each side of the imaginary barrier, no one daring to cross. Ultimately a daring spirit goes over, finds his friends on the other side, speaks a friendly word, and goes contentedly home. Soon he is followed by another; but it was a long time—I should think an hour—before they seemed quite comfortable in crossing the place.

'On Friday morning I waited again till there were no passengers in sight, and then blew a puff of the smoke of—a fragrant, but strong smelling herb—across the path. Exactly the same effect was produced. Long after the smoke was quite vanished (to human eyes) the ants came up to the place, stopped, felt about, went back, came up again, and, in short, were completely bewildered.

'I especially noticed that in this case they were not the least like insects running away from smoke—[*they* would scamper straight off in a fright]—but they were simply baffled by it.

'The facts seem to me to point to *smell* being the sense which guided them. The first experiment might point to touch, but the second could not.

'Perhaps some member of the Natural History Society can throw light upon the point. It is in this hope I have written this note.'

The President called attention to a similar observation by Mr. Hague, of California, recorded in a recent number of 'Nature.'

MEETING HELD JULY 5:—*Exhibition*:—Cardamine impatiens, from Harborough Magna, by Rev. A.

Bloxam; Eggs and Five Stages of the Caterpillar of the Puss Moth, by A. J. Solly.

C. M. Chadwick made some remarks on the fact that the Chickens of the Rev. C. T. Arnold had been eaten up by Rooks, and reported that other similar cases are on record whenever Rooks are hard pressed for food.

The following account of an '*Entomological Expedition to Frankton Wood on June* 17*th*,' by H. A. Bull, was then read:—

'It had been settled for the Entomological Section to have a field day in connection with one which the Uppingham Entomological Section was going to make in a wood near that place. The day before was, however, so very unpropitious that it was deemed expedient, owing to the quantity of rain which had fallen, not to go. It is needless to say that every one was much disappointed; the only thing was to wish for better luck next time. Let us hope that the next time the Entomological Section is going to make an expedition that the then head of the school will be more successful in his attempt to keep up the school barometer—that is to say, if he happen to be serving on the meteorological staff. This time, although he had received most strict injunctions from Mr. Sidgwick "to be sure and have the glass high and steady," he signally failed, and the consequence was that on the day before the glass stood at its lowest point so far this Term. It was in this way that we did not go to Uppingham, but at ten o'clock the day cleared up so well that Mr. Sidgwick determined "to collect his shattered forces" and try his luck at Frankton instead. Accordingly, we started by the train at 12.30 and arrived there, happily without any accident, at 12.45. We then began to set to work, and the first capture was an oak eggar caterpillar, by Vicars; then Mr. Sidgwick found some caterpillars in the catkins of a sallow bush, and two of us spent some time in looking for more. Nothing much, however, turned up till we reached the wood, but when there we began to catch things at once. They were mostly geometræ till some one turned up a "Euphrosyne" or two—that

means, in plain English, "A large pearl-bordered Fritillary," but the initiated will understand what it was by its shorter name, which was probably given it because it was like *something*—but no one knows exactly what. After tramping about the wood a considerable time I turned up a moth called "Heliodes arbuti," of which we took a considerable number altogether. They fly about in long grass, and are extremely hard to see.

'Mr. Sidgwick then took a very good geometer, one of the carpets, which went by the plain and simple name of Cidaria silaceata. However it is new to the list, which is a good thing, and Mr. Sidgwick is to be congratulated for his great dexterity in adding it to his other captures.

'We tried beating for caterpillars into an inverted umbrella, but it was no use; and after a few more insignificant captures—amongst which Solly took a very worn pudibunda, laying its eggs—we turned our steps to the station. It began to rain pretty heavily, but we managed to survive and got home again without accident, though in rather a moist condition.'

The President then read a note on '*Teesdalia nudicaulis*.'

'One fact—properly belonging to the Botanical Section—may be of sufficient interest to be brought before the Society.

'We had growing in the Hillmorton Road a little crucifer, Teesdalia nudicaulis, found in 50 per cent. of the counties, and 16 out of 18 provinces—yet *rare*.

'Hardly recorded anywhere else in the county, except only the Lower Hillmorton Road.

'The last time I found it growing was in 1871.

'In 1872 I did not see it, but J. Armitage found it.

'This year I have looked for it in vain, and it seems to have been driven out by the grass and coarser herbs. A regular struggle for existence has been going on. The poor Teesdalia seedling has failed in the struggle: its old comrades, the Many-coloured Forget-me-Not, the Whitlow Grass, still survive, but the little plant is no more to be found.

'Many plants of Rugby have died out in the memory of man. The Radiola millegrana, Peplis portula, the Mountain Fern, are historical memoirs of the past.

'The Heart's Tongue and Hard Fern, the Foxglove and Golden Rod, in the memory of man known to have been common, are now our rarer plants.

'But as far as I know this is the first old inhabitant which has died away in our time, or since the Society came into existence.

'I may have made a mistake—I only hope I have; for I do not wish to lose the flower; but I have visited the spot 6 times fruitlessly—last Term in the Easter holidays, and again twice this Term, and have not found a single plant, where in 1869 and 1870 I found *thousands.*'

The Rev. T. N. Hutchinson informed the Society of the death of the two Hippocampi, whose portraits were given in the Report for 1872. They died for want of food, as soon as the time of year came at which oysters ceased to be procurable. Sandhoppers were offered them, but without success.

MEETING HELD OCT. 4:—*Donation:* Pair of Laplander's Shoes, by A. W. L. Boyd. Collection of Snakes, etc., sent from Rosario, by N. Larden (O. R.), corresponding member.

Rev. T. N. Hutchinson then exhibited and described 25 Models of Foraminifera, magnified, and Casts of several celebrated Meteorites.

L. Knowles (associate) then read a Paper on '*Coal,*' illustrated by a Box of Specimens.

MEETING HELD OCT. 18:—The Report of the Prize Committee was read, to the effect that, in the competition of Essays embodying original work on any scientific subject, no

first prize had been awarded, but that equal second prizes were to be given to L. Knowles for an Essay on Coal, and V. H. Veley for an Essay on the Cross-fertilization of Plants.

The Essay by V. H. Veley (associate) was then read.

A Paper, by W. B. Lowe (member), on a '*Tour in North Wales*,' was then read.

MEETING HELD NOV. 1:—*Donations:* 18 Specimens of British Marine Animals caught off the West Coast of England, and preserved by C. M. Chadwick (member). Set of Eggs of Scotch Birds, by F. Sykes.

The President commented on the goodness of the Four Collections of Plants sent up for the Holiday Collecting Prize. Some of the rarer specimens were then exhibited.

J. S. Beuttler (associate) read the following Paper on '*The Habits of the Chameleon.*'

'The Chameleon is the most interesting of the Saurian tribe, and inhabits Asia, Africa, and even Southern Europe, as a hot moist atmosphere seems most congenial to it. First, I will say a few words as regards its structure. It has a compressed body, flattened to an edge at the back, and covered with small scales. Its tail is capable of bearing the whole weight of the body, and of turning round objects and grasping them. The five toes of each foot are divided into two sets of three and two respectively. Each set being united with a skin as far as the nails, and being placed in opposition to each other, resembles the foot of a parrot. The ears cannot be seen, as they are concealed under the skin. The eyes are of singular beauty, each eye moving independently of the other, as if on swivels; while one looks backwards, the other can be directed forwards and upwards. They are covered with a thick skin, leaving only the pupil exposed. Its tongue is very peculiarly constructed, consisting of a long tube-like cylinder, with a lump at the end, resembling an acorn with

its cup cut in two. This is covered with an adhesive saliva, to which its prey adheres. The tongue when at rest is contracted, like a telescope, and lies in the bay-like cavity of the mouth. When the Chameleon is irritated it opens its mouth with a hissing noise, when the tongue may be seen in this position. The whole inside of the mouth, as well as the tongue, is of the bright yellow of a ripe apricot. The usual colour of the Chameleon is a light yellowish green, which changes into a dark blue or brownish green, with spots of a prominent red or purple. When irritated it turns into a dark green or black. The change of colour is thought to be produced by the inflation or contraction of its enormous lungs, which force the blood to the surface of the body, contrary to what might be expected. The side of the animal nearest the light is invariably the darkest. The home of the Chameleon is on low shrubs, where its movements are exceedingly sluggish while passing from one branch to another. First raising one foot very cautiously, it will remain in this position for a considerable time; then it moves the foot slowly forward and takes a good grasp of the branch it wishes to reach, and when it has got a firm footing it unwinds its tail, shifts it forward, and recoils it. The Chameleon feeds principally on flies and other small insects, which it catches by swiftly projecting its tongue, then, having drawn the victim into its mouth, it coolly masticates it, quite careless of the poor fly's struggles. Food need not often be given; in fact, it can live for months without taking any; and this has given rise to the popular idea that it lives on air.

'My first Chameleon, which I have here by me in pickle, came from the Cape of Good Hope about four years ago. On its arrival I bought an Oleander tree, on which it soon got to be at home, and as a rule you always found it on that part which faced the window, but as night came on it retreated towards the centre of the tree. Whenever the tassel of the blind was within reach of the plant it would make frantic attempts to get on it, and when it reached it, it would climb to the frame of the window and rush backwards and forwards, clawing and beating its head along the glass. We were for some time puzzled to know

what this could mean, until we saw one day that it was his shadow that he was so eager to fight. However, as a rule, it was of a most gentle and quiet disposition, and eventually grew to be quite tame, taking flies from our fingers and watching for them as soon as we entered the room. On the approach of winter he became torpid, and, as owing to a case of illness in the house, he was not so carefully looked after, he got lost. Months passed and we saw nothing of him. However, in spring, when the weather was getting warm again, he was found creeping out of the ash-pit, but unfortunately with his tail crushed, as we think in the ash-pit door. The part of the tail where it was broken may be plainly seen. We washed its mouth and throat, which were full of ashes, and nursed and doctored it as well as we could, but it only survived a couple of hours. It would appear that when the cold weather set in he crept into the fire-place for warmth, and got swept out and thrown away with the cinders, where there is no doubt he existed for at least six months without food of any kind.

Several years elapsed before I could procure another. However four months ago I was lucky enough to get the one which I now exhibit. There is this striking difference between the two, that, whereas the first was most gentle and almost attachable, this one repels every advance of friendship with an angry hiss. We never knew that the former had a voice at all; this one's snarl may be heard a dozen times a day. The general opinion is that this is the lady. Soon after she came she began to shed her skin; the tail and the hind legs were the first to peel off, and the pieces of skin hanging about gave her quite a beggarly appearance; then the head; and lastly the back, where one tiny piece still remains. I have with me portions of the skin, which I picked up as they dropped off. It has a strange habit, when anyone approaches nearer than it likes, of puffing out its body with its ribs distended and inflating itself till it is almost as large again. In taking its food it is very shy, and the only way to see it dart out its tongue is to put a dead fly on a leaf and hide out of sight—when at first it seems to take no notice of it at

all, but, after a few minutes, turning its head swiftly towards the leaf, it shoots out its tongue, and draws it back so quickly that unless you are watching very intently you will not be able to see it.* It assumes various positions. When at rest it lies extended along a branch, with its head upwards; sometimes it supports its body with its hind legs and tail alone, waving its front paws in the air in the same manner as a praying mantis does. In cloudy weather it never stirs; sometimes even scarcely opening its eyes the whole day; but a few hours' sunshine warms it into activity. At first we thought that it did not require any water, but one day when the tree happened to be wetted in a shower we saw the Chameleon greedily sucking the water off the leaves. Ever since we have put daily a few drops of water on the leaves, which it sucks when thirsty. If you touch one of its sides with your finger it will dart at it with its mouth wide open, as if it intended to bite, but it rarely does; however, even if it did, its bite is perfectly harmless. At night, if you carefully approach the Chameleon with a light, the eye turned towards the flame will open and move about, and the corresponding side will change colour, while the other eye will remain for some time fast closed in sleep and no change will be seen in the colouring of the body. There is no difficulty in making it change its colour at any time. For instance, in gas light it assumes a light green with an ashy white underneath. If you place it on a red ground the copper colour becomes more prominent than the green, but the most striking change is seen when it is put on anything black, for then it grows almost as black as the ground on which it is placed. When put on any flat surface it tries hard to get off, but as its claws are only made for climbing, it sprawls about in a most hopeless manner, especially if it is put on a sheet of glass. When it falls down, from the breaking of a leaf or the snapping of a bough, it never seems to hurt itself, for, like the cat, it falls on its legs. In fact, the former one fell from the balcony on to the stone steps beneath—a height,

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* The greatest length we have ever seen it shoot out its tongue was a little over four inches.

I should think, of at least 20 feet—without any apparent injury. In feeding, it prefers the small house fly, but spits the blue bottle out of its mouth with disgust; it rejects also all those that are not alive, or at least freshly killed; two or three flies a day are quite sufficient for it. But unless it hibernates during the winter, as flies grow scarce, I am afraid that it will share the fate of the Hippocampi.'

R. D. Oldham (associate) then exhibited a superb series of 40 Photographs of Scenery in the North Punjaub.

MEETING HELD NOV. 15:—The following Paper was read by Mr. R. H. Scott, F.R.S. (O. R.), Director of the Meteorological Office, London.

'THE WEATHER.

'The state of the weather is, as is well known, the stock subject of conversation for every Englishman, and a most useful beginning is it for starting a dinner-party conversation. There is good reason for this, as we have almost the most changeable climate of any in the world. In tropical countries, where the year is divided into a wet season and a dry one, and in India especially, where the alternate monsoons bring with them each its own kind of weather for months at a time, it is usually pretty easy to form an idea of the probable character of the weather for some time beforehand; but in these islands, as I shall try to show you, it is most venturesome to attempt to predict a fine day, even for so short a time as two days in advance. In fact, it has very fairly been said that no one who has any character for wisdom to lose would ever set up as a weather prophet.

'Fishermen, gamekeepers, and shepherds, and other men who are out all day long, in all weathers, can make *for their own district* a very good guess as to the chances of weather, from local signs. From the experiences and sayings of these men the mass of weather lore, mostly in rhyme, which is current everywhere, though in various forms, has been ac-

cumulated. Such is the monkish couplet about Candlemas Day.

'"Si sol claruerit se Virgine purificante,
Majus erit frigus post festum quam fuit ante."'

'Of English sayings we have—

'"If the grass grows in January 'twill grow the worse for it all the year."'

'"A handful of March dust is worth a king's ransom."'

'"April showers
Make May flowers."'

'"A dripping June
Sets things in tune."'

'A very useful saying for any one who is fond of fishing is—

"When the mist creeps up the hill,
Fisher, out and try your skill.
When the mist begins to nod,
Fisher, then put past your rod."'

'From this very district the most important collection of these traditions has been handed down in the shape of the famous Rules of the Shepherd of Banbury.

'It is utter folly to laugh at these rules, for several of them are most valuable and useful everywhere, though the greater part are only true for each special district, and will lead us quite astray when we try to apply them in a distant part of the country.

'It must be confessed that we, with apparently the most perfect scientific machinery for recording weather at our command, must be contented to be often more at fault about coming weather, for any particular district, than many an old countryman who can barely read and write, but whose wits for weather wisdom have been sharpened by his mode of life in the open air every day, and all day long.

'This being the case, you may well ask "cui bono" the stores of observations which are made, day by day, at all the countless stations over the globe, and in England in particular. The answer is, luckily, not far to seek. It is absolutely necessary to have this information from a great many stations, in

order to get an accurate record of the weather which is felt at each station, and thereby collect the materials for the study, firstly of our Climate, and secondly of our Weather.

'If we contrast Astronomical with Meteorological stations we shall soon see the difference. The astronomer is looking at the stars, and they are so far off that it makes little matter whether he is observing them from Greenwich or from Rugby; all that is wanted for an astronomical observatory is a site where you have a clear view of the sky, and where the sky itself is usually clear.

'In Meteorology the case is widely different, for the phenomena to be observed take place in our own atmosphere, and what we have to ascertain from the records is not only the actual observation taken, but how that observation differs from the same kind of observation taken at the same time—say at Oxford or Birmingham, or at any other station.

'The Meteorological observations, particularly of temperature, wind and rain, are affected by distance from the coast, by height above the sea, by the character of the country, whether hill or flat, and even by the soil itself. You will, of course, know how the barometrical observations are influenced by height above the sea and by temperature, but as corrections can be applied to the readings for these effects I have not specially noticed them.

'We may say that there are three great uses to which observations in our science can be applied.

'I. *Local Weather Study.*

'II. *Study of Local Climate,* as a contribution to our knowledge of the climate of the kingdom, and thereby of that of Europe and the world at large.

'III. *General Weather Study,* though for this last the observations would be more useful if they were telegraphed daily to a central station, such as my office in London, where they could be compared with other observations made at the same time elsewhere. This is only a question of money, and the sole reason why Rugby is not one of our telegraphic stations is that we do not want, nor if we did could we pay for, more stations than we have in central England.

'The two last-named inquiries, climate and general weather, are carried on in the Meteorological office, and before I speak of them I must say a few words as to the *Local Weather Study*, as that is an inquiry which any one can carry on for himself. There are an abundance of rules for this given in every text-book, and though the results attainable fall far short of the knowledge of weather to be gained from telegraphic reports, it often happens that one is out of the way of the daily weather reports, and even of telegraphy (for storm warnings), and has nothing to trust to but one's own observations and one's dead knowledge. I suppose always that one has a barometer and a pair of thermometers, dry and wet bulb, at least. The first thing to do is to observe regularly; the next is to put down the observations on a ruled form, so as to see how the lines or curves run, as it is quite impossible to trace at a glance all the little changes shown by the readings if you have to look down a column of figures.

'If then you study carefully the course of these lines, marking whether or not they are rising or falling, and whether the change is going on slowly or quickly, a great deal of knowledge may be gained.

'It is always most important to observe the wind carefully and to watch any change in its direction, and also whether or not the clouds are moving in the same direction as the wind at the earth's surface is blowing. The appearance and form of the clouds are also very valuable as signs of what is going on in the atmosphere. By such means as these we shall gain a very fair knowledge of weather, but it would take more than all the time we have for this Paper to give you a full explanation of this part of the subject.

'I must now proceed to tell you what we do in the Meteorological Office in London as regards weather study, which forms, after all, but a part of our duties. I find that not one person in every dozen whom I meet has the faintest conception of what we do there, so perhaps you will let me digress for a minute or two to explain it to you.

'We have three branches.

'I. The original object of the office was *Ocean Meteorology.*

This is studied by getting ships' captains to take observations, just like yours here. From their logs we take out, in the first instance, the wind observations, and so by comparison find out which are the best routes (seldom the most direct) for ships from port to port. In the second place, we study the climate of various parts of the sea, and notice how that affects the climate of the land. These observations can also be used for weather inquiry, for, as you will see presently, if we could possibly get news of what is going on at sea off the coast of Ireland and Scotland to-day, our task of telling what the weather will probably be on Monday would be comparatively easy.

'II. The next branch is the study of our *Climate*, and for this we chiefly make out averages for each class of observations for days, months, and years, and compare them with each other, thereby gaining information which enables us to tell why corn will pay as a crop in central England, while it will be better to have green crops or grazing land in the West of Scotland, or in Ireland. All questions as to the healthiness and the suitability of places for invalids must come to this branch.

'III. The third branch is *Weather Telegraphy*, and this is the subject on which I have to speak especially this evening. It is also naturally the part of our work which attracts the most public notice, though not at all the most really important inquiry that we have to pursue. The proceedings in this department are, in principle, simple enough. We receive every morning some 50 reports, taken nearly at the same time, at various places in these islands and on the adjacent coasts of the Continent. These observations are then laid down on a chart so as to enable us to detect any discrepancy between the reports from adjacent stations, and to see over what districts such and such a general type of weather prevails.

'As soon as this chart has been considered, and our ideas as to present and probable weather have been formed, we send off our report to the newspapers, issue, if necessary, warnings to the coasts, and prepare our chart for publication.

'You may now ask what principles of air motion we have to guide us in "forming our ideas," and this I shall try to ex-

plain; but it is not an easy matter to do so, owing to the difficulty of finding suitable illustrations of the subject.

'I suppose you all know the points of resemblance and of contrast between a *liquid* and a *gas*. In both cases the particles have much greater freedom of motion than in a solid, but while a liquid can be kept in an open vessel, in which its surface will remain level, a gas must be enclosed in a complete envelope, else it will quickly flow out and get mixed with the surrounding air. Both states of matter, however, agree in this that if there be produced in a mass of either a surplus or a deficiency of molecules, the tendency of the whole mass will be to put an end to this state of things, and a motion will take place amongst the particles, so that after a short time they will all be at rest again.

'You can see all this taking place in a basin of water, if you pour water in or scoop out some that is in; and what takes place in a mass of gas is very similar, but what corresponds to scooping water out of a basin is a *reduction of pressure*, while what corresponds to the addition of water is an *increase of pressure*. These are indicated, as regards the air, the first by a fall, the second by a rise of the barometer.

'You know that the barometer measures the weight of the air, or, so to speak, the quantity of air over our heads at any time, and so shows whether there be more or less than the proper amount. Whenever there is a change in the pressure, however produced, at any spot, the air all about that spot is set in motion to restore equilibrium, and so WIND is produced.

'It is the direction and force of the wind which are the causes of all our different kinds of weather. We all of us know that S. W. winds present a strong contrast to N. E. ones, the former being warm and moist, the latter cold and dry. It is a remark as old as Aristotle (in the Politics) that as there are only two constitutions, free and despotic, so there are only two great winds, north and south, and all the others are merely secondary currents of air.

'I have told you that the air is set in motion, and wind produced, to restore equilibrium, but I have not explained the

principles according to which that motion takes place and the wind blows.

'These principles are quite definite and easily remembered. The wind does not simply rush in from all sides to fill up the vacuum, but moves according to laws, and blows in great curls or sweeps. If the wind is produced by an area of low pressure the circulation will be what is termed cyclonic, or *against* the hands of a watch; if by an area of high pressure it will be anti-cyclonic, or *with* watch hands. I speak in both cases of the northern hemisphere.

'Let us now return to my illustration taken from water motion. The atmosphere over our heads is never really at rest, but is constantly moving on more or less like a gigantic river. If such a river be flowing rapidly you may often see waves and hollows on its surface causing eddies and cross motions. We may suppose that the surface of our atmospheric currents, if we could only see it, would present an appearance somewhat similar, but the waves and hollows would be represented by patches of excessive or defective barometrical pressure, each with its own proper eddies and wind circulations; and these are acting one on another and causing various disturbances; one eddy dying out, another increasing; here two merging into one another, there a large one breaking up into little ones.

'It is a problem of the greatest difficulty to account for the origin of these circulations; we must only admit the fact of their existence, and explain their properties and behaviour as best we can. They vary in size from the local whirlwinds, only a few yards in diameter, like that near Banbury on the 30th of November, 1872, which sweep across half a county, leaving their track an utter wreck, and the gigantic wind systems, like that of January 19, 1873, of which the W. gales of the southern side were felt in Spain, while E. winds were reported from Iceland. In fact, the entire wind circulation of the globe is related to barometrical pressure, and takes place in great eddying gushes of air, round definite areas of high and low pressure. Such an area of high pressure, causing an anticyclone, is found near Madeira, while the neighbourhood of

Iceland is a constant centre of low pressure, with its cyclonic circulation round it.

'This statement, that all the wind is related to barometrical pressure, contains a great principle, and is, in fact, the most important discovery as to weather which has been made for a long time.

'In former days it was said that when the barometer was high the wind would be E., and when it was low the wind would be W. This idea is quite antiquated; we know that the wind always blows according to a fixed rule—BUYS BALLOT'S LAW, after the Dutch professor of that name, who first saw its importance. It is as follows:—"Stand with your back to the wind and the barometer will be lower on your left hand than on your right."

'It is easy to test this principle by any of the charts of storms on the wall. The lines, called *Isobars*, join the places where the barometer readings are the same, and they run nearly parallel to each other round the central area, while the wind arrows lie reasonably nearly parallel to these lines. The force of the wind is greater the nearer the lines approach each other, or the greater is the difference in reading between stations close together.

'We know then, from this law, that whenever we have a W. wind the barometer must be lower to the north of us than it is here, and conversely we know that if the barometer be lower, or if it be getting lower in Scotland than here, we must have a W. wind, and a stronger one the greater the difference between the two readings.

'Here you have the first glimpse of the principles on which we judge of wind, and consequently of weather—viz., by the barometer, or as it is vulgarly, but not inaptly termed, the weather glass.

'Let us now see what other aids we have.

'I have already reminded you that the air of the S. W. wind presents a strong contrast to that of the N. E., and if I were to lay down on a chart the conditions of temperature and of cloud and rain for any one of the storms, you would see that on the eastern and southern sides, where we have the S. and

S. W. winds, the air will be warm with mist and rain, while on the western and northern sides, where we have the N. and N. E. winds, the air will be cold and dry.

'In fact, one of the most usual occurrences towards the end of a S. W. gale is that a heavy shower of rain falls, the wind suddenly shifts to N. W., bringing on a clear blue sky.

'Thus you see that over and above the indications of a coming change of weather given by the barometer, we can get most valuable corroborative evidence from the temperature, and the dampness, or the contrary, of the air.

'In addition, there are other most important signs, in the form and character of the clouds, the appearance of the sun and moon, the clearness or haziness of the air, and, if you are near the open sea, the height of the waves and the direction from which they are coming; and, above all, the motion of the upper clouds, inasmuch as storms usually begin aloft, owing to various causes. All such observations as these come under the head of local signs, as they cannot be observed by instruments, and so require a practised eye to recognise them, as I explained at the beginning of the Paper.

'This is precisely the very weakest point of the whole system of telegraphy, and here is where we fall short of the knowledge of fishermen. Over and over again it has happened to me, on my yearly tour of inspection round the coast, to notice coming changes of weather long before our regular telegraphic observers had recognized the signs, though quite unmistakeable to the eye of every one whose business depended on the weather—be he fisherman, farmer, or even Clerk of the Weather. Our telegraphic reporters do their work as a duty, and only very few of them really take a pride in it, so that we cannot trust them to be always on the look-out till we can pay pay them higher or interest them more in their work.

'It is now time to speak of our system of collecting our intelligence and issuing the results to the public.

'The stations are represented on the diagram, and their position has been chosen so as to give the best information we can get. You will see that on many parts of the West Coast we have no stations, partly because it is so thinly inhabited that

there are hardly any telegraphic stations along it, and partly because it is so mountainous that the wind reported will not have blown true, so that if we trusted it we should often be led astray, for the first signs of a storm are usually very light puffs of southerly wind, which will not be felt at all in valleys which are not open to the south.

'If then at any of our stations we find that the reports show any of the signs of an approaching system of wind which I have described to you (let us take a cyclonic system as example, as by far the most usual and also the most important as regards storms), we must first see from our chart how far the reports confirm each other and how far the influence extends.

'Then comes a very difficult task, that of forming a judgment as to whether or not the system will bring a storm with it. This is decided mainly by the rate at which the barometer is falling and the extent of coast affected.

'We have next to try to discover what the probable shape and size of the system will be, and at what rate and in what direction it is moving. As to the two last points we can rarely make up our minds before the gale has burst upon us.

'The rate of advance of a storm varies from about ten miles an hour to about forty, but as a very general rule we may say that the weather which sets in over Ireland to-day will not come to England till to-morrow.

'As regards the direction of motion, that is generally from the westward, but it also takes place from most other points of the compass, the advance from the eastward being, however, excessively rare in these islands.

'Frôm this circumstance of the usual movement, from W. towards E., of the weather systems, you will see that our West Coasts are the first to feel the brunt of storms, and that if by any possibility we could get news from the Atlantic—say half way across to America—we should gain an enormous advantage. This is unfortunately not to be hoped for, and America, or even Newfoundland, is too far off for us to be able to trust the reports absolutely, as the weather changes its character in crossing the ocean.

'Hence I can assert, without fear of contradiction, that,

with the exception of my friend, Professor Mohn, in Norway, I have, in studying the weather in England, the most difficult task of all the chiefs of weather offices in Europe; and, as a proof of this, I may say that I can succeed far better in foretelling the weather for Holland and Germany than for our own coasts. In the year 1872 they had 23 storms in Hamburg, and I warned them of 22. I only wish I could do as much for our own coasts, or that I had observers out at sea.

'This will show you, in a general sort of way, what we know about storms, which is simply that as soon as we learn that a storm has shown itself in any part of the region covered by our telegraphic network, we at once telegraph the news to all whom, in our opinion, it may concern.

'Let us now see what insight we have into the probable character of a disturbance which is approaching, and consequently what we know as to the coasts threatened and the direction of the storm by which they are threatened.

'This is, unfortunately, not very much, for I have told you already that we seldom know much about the size of a storm before it has begun; but there are some general principles of great value, which are mostly deductions from Buys Ballot's Law.

'I have already stated what that law is; let us now apply it to the general distribution of pressure. Whenever the barometer is higher in France than it is in England, and in England than in Scotland, there will be a general W. wind. If now a cyclonic system moves across central England, the wind on the southern side of the centre will be westerly, and for a given depth of the barometric depression must blow harder the higher the barometer is in France. On the northern side there ought to be east winds, but, for them to blow hard, the barometer must be much higher in the North of Scotland than at the centre of the storm. But as it very often happens that the lowest reading in England is actually higher than the reading in the North of Scotland (owing to the influence of the Icelandic area of low pressure, of which I spoke some time ago), it is seldom that we can get up the conditions for an easterly gale.

'So when the barometer is highest in Denmark and Norway, and a cyclonic storm comes on, it will blow hardest from the S. and S. E., and the gale will be much worse on our East Coast than on the West.

'As to the north gales we can seldom tell much about them beforehand on our West Coasts, as they come at the tail of a storm, and the high pressure which causes them lies out to seaward; but we know that whenever the barometer is very high over Ireland there is great danger of northerly gales on the East Coast of England.

'It is then to the distribution of pressure that we are to look for the probable character of our storms, and we are gradually coming to the conclusion that to the same relations of pressure we are to look for the probable direction of motion of the storms. If we knew this we should, indeed, have made a grand step in advance.

'It is always to the general distribution of pressure that we are to look for the ordinary indications of a change in the general type of our weather.

'Let us take the coming winter, when most of us wish for some skating. What are we to look for in the daily weather reports as the signs of a coming frost?

'In the first place, we must see whether or not the barometer in France and the South continues high: if it does, we need never trust an odd cold day to be the commencement of a frost.

'Let the readings in France fall well below those in the North of Scotland—not too much so, for that will cause too strong a wind, and will probably be only the precursor of an opposite change; and let us see the frost well established over the Baltic and Norway, with light airs of wind in these islands, and with a good deal of fog on our South-west Coasts; we shall have a fair chance of a week or two of hard black frost.

'If this has once set in, the first signs of its breaking up will be quite unmistakeable; there will be "cirrus" clouds and coloured rings round the moon, with perhaps a lunar halo. If this appears for one or two nights in succession you

may be sure that the frost will be checked, perhaps utterly broken, and that there will be a chance of hunting.

'It is not possible to go further into the subject in the course of such a Paper as this, but I hope I have said enough to show you that we have some definite principles to guide us, although these are far from perfect as yet. That we can get some good out of them is shown, on the principle that "the proof of the pudding is in the eating," by the fact that we were generally right in giving news of and foreseeing 80 out of 100 cases of storms last year.'

MEETING HELD DEC. 6 :—*Exhibition :* Local and Holiday Prize Collections of Lepidoptera, by A. J. Solly.

The following Paper was read by Mr. W. C. Marshall (corresponding member) on '*Mode of Escape of Sesia apiformis from its Cocoon*':—

'The subject of the short Paper I am sending to the Society is the way in which certain moths escape from their cocoons; but perhaps it would be more proper to call it a note on the habits of Sesia apiformis, as my remarks are almost entirely suggested by that insect.

'The way in which many moths escape from their cocoons has long been a puzzle. Of course a stout covering is of great advantage in protecting the helpless chrysalis from its numerous enemies—birds, mice, centipedes, earwigs, woodlice, &c.—and one is not surprised to find the protection common; but I think it is surprising that the means of escape which one would expect to accompany this protection are not more obvious than they are.

'I believe these moths have two ways of getting out.

'First, by excreting some solvent of the glue of which the cocoons of many are, to a large extent, made. I have seen this suggested, but have never seen any positive evidence on the point. Wherever this is the means of escape I think the moth breaks through the chrysalis before it breaks through the

cocoon, and the chrysalis will be found in the cocoon after the moth has come out. I believe the Puss Moth (Dicranura vinula) and the December Moth (Pœcilocampa Populi) are good instances.

'The second way of escape is mechanical, by rubbing or scraping a hole in the cocoon, through which the insect emerges. In this case the chrysalis comes out of the cocoon before the insect comes out of the chrysalis, and the empty chrysalis will be found either entirely free from the cocoon, or more frequently half out. It is an instance of this that I wish particularly to describe.

'The caterpillar of Sesia apiformis (the Hornet Moth) feeds in the roots of poplars, and when it is full grown it eats its way to the surface of the tree; if it is above the level of the ground, it stops when there is a very thin layer of bark over it; if below the level of the ground, it works its way right out into the soil. In either case it spins a tough cocoon made of small pieces of wood glued together, and the whole bound up and lined with silk. This takes place about the beginning of November, the caterpillar hybernates and changes to a chrysalis in March, and the moth comes out in May. I kept a number of the cocoons at Cambridge. The first sign of life I perceived in the spring was a distinct scraping noise, and this went on for two or three days before any moths came out. I took a cocoon out and cut a hole in the side. When he recovered from the disturbance the chrysalis began turning round in the cocoon, first in one direction and then in the other; and from the way in which he occasionally slipped seemed to be exerting a good deal of force.

'When the cocoon eventually breaks it does so in a remarkable way: a small round cap comes off the top, much in the way in which the capsule of a Pimpernel opens, and sometimes nearly as neat. The chrysalis then comes out of the cocoon, either partially or entirely, then splits down the back and discloses the insect.

'Now, if you will look at the drawing of the insect (Plate ii.) you will see that the chrysalis is a peculiar one. The covering of the abdomen is very extensible, and each segment

has on the *back* one or two rows of spines or teeth pointing downwards. Also, there are three points on the front of the head, the principal one (A), where the antennæ meet, is chisel-shaped and very hard, the other two (B) stand over the base of the palpi.

'It is evident that by expanding and contracting the segments with a wriggling motion the insect can easily turn round, and at the same time keep its head pressed against the top of the cocoon.

'This expansion seems to take place in a rhythmical way, so that one segment after another comes in contact with the side of the cocoon in regular order. You will also see that the position of the spines on the *back* of the abdomen will cause the *front* of the head, on which are the three points, to be pressed against the side. The conclusion is irresistible that these points cut the top off the cocoon, or, at any rate, so weaken the line they rub as to determine the point of fracture. And if this is the case, I think it forms a remarkable instance of correlation of form and habit to attain an end of undoubted advantage to the insect, and is a fact especially interesting from the natural selection point of view. I think similar habits are to be expected in the Sesiadæ, Zeuzeridæ and Hepialidæ, which have, as far as I have seen, chrysalises of similar form. The common Burnet Moth, Zygæna Filipendulæ, which is abundant about Rugby, I fancy breaks through its chrysalis in a similar way. I kept a number when I was at Rugby, and observed them jumping about in a very ridiculous way before they came out. The chrysalis has a ridge down the back, if I remember right, and the cocoon splits frequently in a line corresponding to this; but I cannot speak with any certainty. This might easily be settled by any member of the Society who will take the trouble to gather a dozen or two of the cocoons.'

Dr. Oldham, Director of the Geological Survey of India, then read the following Paper on the '*Coal Fields of British India*':—

'There would seem to be much want of any general information regarding the extent, or even the existence of Coal

in British India, and a few words on the subject may be interesting to the Society.

'Briefly alluding to the immense area of British India, he sketched out its main physical features, shewed that the peninsula was markedly separated from the Himalayan area on the north and from the hill country to the west of the Indus by an immense plain, or series of plains, the highest point of which scarcely exceeded 400 feet above level of sea. The peninsula had, in fact, been formerly a great island. The direction and character of the hill ranges in the peninsula proper were then noticed, and the very peculiar distribution of the drainage of the country, depending on this arrangement of the hilly ranges, indicated.

'In geological structure India presented a good deal of simplicity, due to the very large areas covered by the same formations, combined with a large amount of complexity and difficulty—depending, in part, on the isolated and limited areas over which some of the rocks occur, and the comparative absence of organic remains by which the succession could be established.

'At the base of all, and covering an immense area in the south and centre of the peninsula, and also in the Himalaya, comes highly metamorphic gneiss, so crystalline in many places as to become a true granite, and throughout of granitoid type. This is found traversed by numerous reefs or veins of quartz, of pegmatite, of felspar (orthoclase), and, in most places, by a most wonderful series of trap dykes—almost too numerous to count, and though rarely exceeding a few feet in width, often preserving for fifty miles and more a perfectly rectilinear direction, with but very slight variation in size or mineral character.

'Next in succession come a series of schistose and quartzitic rocks, much cleaved and greatly contorted, to which, in the South of India, the name of *Kuddapa* rocks has been given, from their extensive occurrence in the Kuddapa districts. In a similar way the name of the adjoining district of *Kurnool* has been given to the group of rocks immediately succeeding, in that part of the country, the Kuddapas. There

is between the two, however, a marked and great unconformity, indicating a considerable lapse of time. In other parts of the country, further north, similar rocks have been met with, and, in the absence of any positive proofs of identity, local names have been given by the officers of the Geological Survey of India (*Gwalior*, *Sub-Kymore*, *Bijawur*, &c.): while, at the same time, as the upper portion of these formations appeared at first to have connection with the lower portion of the next succeeding great group in ascending order, to which the name of *Vindhyan* had been given, as being best seen in the great Vindhyan range of hills, these older groups had often been spoken of as Lower Vindhyan. The Vindhyan series, which has just been mentioned, largely consists of sandstones, the prevailing colours of which are red and grey. But there are also intercalated limestones and clays of varying character, which enable the entire series to be easily subdivided into three groups in descending order (*Bundair*, *Rewah*, and *Kymore*). These rocks cover a very large area—nearly 100,000 square miles—and are of great thickness. As yet, no fossils sufficiently distinct to determine the geological age of these rocks have been found. But, judging from analogy in other respects, they are probably of the age, or nearly of the age, of the old red sandstone of Europe. There is every probability also that the entire series in India is of freshwater, or rather estuarine formation, while the varying thickness and varying mineral character of the beds enable us to indicate the probable direction of the waters carrying down these deposits, and the possible limits of these depositing forces.

'To this great Vindhyan series, with the intervention of a great break and unconformity, succeeds a very thick and widely-deposited series of sandstones and shales, apparently forming one continuous group with local unconformities, characterized by one common fact—namely, that the remains of terrestrial plants occur throughout wherever the conditions for their preservation were favourable. To this entire series, therefore, embracing several very distinct groups, but all characterized by this fact of freshwater and terrestrial formation, a general name of the "plant-bearing series" had been given, as a convenient distinction.

'The lowermost group of this assemblage of formations consists of widely-spread rocks of peculiar type, singularly constant as regards this type, and even its minor characteristics. These rocks were first described in connection with the Talcheer field in Orissa, and the name of *Talcheer* was given to the series. Without entering into any great detail, we may note the most remarkable features in these rocks, which is the occurrence of beds made up of fine silt, in which are imbedded large—often many tons in weight—blocks of older rocks of various kinds, carried from far-distant localities, and frequently much worn. This peculiar admixture of fine silty matrix with huge blocks of hard rocks imbedded, led at once to the suggestion that these deposits owed their origin to glacial forces, presenting, as they did, many of the features characteristic of such ice-borne deposits in these countries. There was nevertheless a difficulty in admitting the existence of glacial conditions within the tropics and under the blazing suns of Indian latitudes, and though no other hypothesis appeared capable of meeting the facts, further evidence was anxiously sought for. No scratched blocks had been found, nor had any furrowing or polishing of the underlying masses been traced. And this continued to be the state of the question for some years, until more recently, this additional evidence was found under conditions favourable for its preservation; and blocks of hard syenitic granite, etc., as beautifully polished, scored and furrowed as any derived from the glacial deposits of more northern latitudes, supplied convincing proof of the accuracy of the suggestion first thrown out by Mr. W. Blanford, who was the original describer of these rocks.

'Associated with these "boulder-beds" are fine muds, now thinly laminated shales, much sub-divided and breaking up into small angular fragments, from which the name of "needle shales" was given to them; and also sandstones, equally jointed and breaking into small dice-like pieces, whence the name of "tesselated sandstones." This peculiar group, known to Indian geologists as the Talcheer series, forms throughout the country generally the immediate forerunner of the Indian coal-measures. There is generally, not always, a slight un-

conformity between the two, but there is also a certain slight amount of transitional passage, evidencing a continuity of conditions of deposit.

'To the formation containing all the productive coal of the Indian Peninsula the Indian Geological Survey has given the name of the *Damûda* series, from the name of the river Damuda, in the valley of which by much the most important of the coal-fields worked in India is situated. This river is an affluent of the Ganges, or rather of that portion of the Ganges which passes Calcutta and is called the Hooghly.

'The Damûda series is probably best seen in its more easterly developments, and no portion of it is so extensively worked, and therefore so accessible, as the coal-field situated near the village of Ranigunj, and which is therefore often called the Ranigunj field (about 120 miles from Calcutta). Here the entire group is readily divisible into three, the middle portion of the series consisting of *ironstone shales*, of considerable thickness, which are coextensive with the field. Below these, forming the *Barákar*, or lower group, are thick massive sandstones, with some shales and thick irregularly developed beds of coal, while above the ironstone shales are also numerous beds of sandstone, for the most part slightly calcareous, and numerous associated seams of coal and coaly shale. This constitutes what has been called the *Ranigunj* group. The whole Damûda series in the Ranigunj field cannot have less than 10,000 feet thickness, of which this upper group is nearly 5,000. The Ranigunj field or basin contains about 600 square miles of coal-bearing country. There are some fifty collieries at work. The seams vary from 4 feet 6 inches to 35 feet, and the field cannot contain less than fourteen thousand millions of tons of coal. Up to the present, this is by far the most productive and most largely worked field in India. In 1868 it produced more than nine-tenths of the entire quantity raised.

'Passing westward the coal-bearing rocks exhibit a steady and continuous change in their character. The very marked central group of the *ironstone shales* dies out, while at the same time the upper group also disappears, or becomes re-

placed by a series of beds which contain no deposits of coal. The coal becomes concentrated also in a few thick beds of irregular character, confined to the lower portion of the series. This marked change is further not due to the denudation or wearing away of the portions not now represented, but to a difference in the original deposits—a fact of importance when discussing the origin of these fields.

'As seen on the map of India, shewing these coal-fields, they occur, as in most other countries, in isolated basins or local fields. There is very strong evidence that, to a large extent, in India, this isolation or separation is due to original limitation of deposit, and not, as in most cases in this country is supposed to be the case, to separation by denudation and partial removal of the intervening portions. A reference to the geological map will also shew the general distribution of these coal-fields. It will be noticed that they constitute an irregular belt from the vicinity of the shores of the Bay of Bengal on the east to some hundred miles from Bombay and the Arabian Sea on the west. Although every portion of the country has not yet been examined, sufficient has been done to enable us to state with tolerable confidence that throughout the peninsula of India, south of the river Kistna or Krishna, throughout the whole of Western India, embracing the Bombay Presidency, throughout Rajputana, Indore, Gwalior, Guzerat, Sind, in the greater part of the N. W. provinces, and the great Gangetic plains, no coal is known, and it is highly probable none will be found.

'So far, therefore, as area is concerned, the coal-bearing rocks cover only a small portion, relatively, of the surface of the country. Still that area, small as it may be compared with the immense area of British India, is by no means small in reality. The whole is certainly not less than 35,000 square miles, while the entire area of the coal-bearing rocks in Great Britain is not one-half this. Viewed merely in this way, as to area of coal-bearing rocks, there would only be four states which can shew a greater than India, namely, the United States of America (500,000 square miles), China (400,000), Australia (240,000), Russia (150,000), India (35,000). There

are, however, many other points to be considered in forming an estimate of the value of such deposits, besides the mere question of extent of area.

'Confined as all the coals of India are to one great belt of country, the basins may still be viewed more in detail in immediate connexion with the prominent physical features of the country. And studied in this way it will be found that they at once combine into groups defined by, or belonging to, the great drainage courses of the country. There is thus a group of basins belonging to the Damûda river basin and those of its affluents; a group of fields belonging to the Sone drainage basin; to that of the Mahanuddy; of the Nerbudda; of the Godavery, &c. And, tracing out this farther, we are led to see the existence of very strong evidence,—coupled with the facts already noticed of the original limitation of the basins of deposition and the variation in the mineral characters of the rocks,—proving that the main features of the great drainage basins of the country have been marked out, and have continued, with only minor alterations, since the periods preceding the Damûda formation, or even the Talcheer.

'All the coals of India agree in texture and physical structure; all are laminated, being built up of successive fine layers of highly fossilized vegetable matter and of fine silt or mud, often highly charged with carbonaceous matter, but often also nearly entirely composed of earthy or clayey substances. Thin laminated pieces of mineralized charcoal are abundant. On the whole, they present a less highly mineralized aspect than the majority of English coals. They are all free-burning, yield a poor coke or none, and are of lower heating value than English coals. This is mainly due to the larger quantity of ash contained, which varies from 6 to 20 per cent. This renders the coals less valuable, especially wherever it is necessary to transport them to any great distance, as there is an average amount of 12 or 13 per cent. of useless matter to be carried with the actual fuel. The fixed carbon in these Indian coals also seldom exceeds 60 per cent. Some contain a very distinct admixture of phosphorus. In all there is a varying amount of sulphur, pyrites being in some cases abundant.

'The true Geological age of these coal-fields is a question to which very widely differing answers have been given. In most works, in which any reference to the matter has been made, the Indian coal is stated to be of Oolitic age. In others, again, to be true Carboniferous. The absence of any fossils other than plants has been the great cause of this doubt. Plants are well known to have by no means the same defined and distinctive distribution geologically as molluscan and other animal remains. And, in addition to this, the evidence derived from these plants, imperfect in itself, has been rendered doubly confused and conflicting by misconceptions as to their distribution, or misstatements as to their relations.

'I gave in a few words a sketch of the various formations older than, and preceding, the coal-bearing rocks in India, as their nature and character was needed to account for the mineral character of these coal-rocks, derived largely from their debris. But I must not enter on the question of the more recent series, further than to allude to one which has been confounded with these coal-bearing rocks. This formation, to which I gave the name of *Rajmahal*, from its occurring in the Rajmahal hills, is remarkable for containing an immense number and great variety of the remains of Cycadaceous plants, with some ferns. Several of these Cycadaceous remains are identical with others which were originally described from the rocks in Cutch, another Indian locality. Recent researches in Cutch, where there occurs an abundance of marine molluscous remains, distinctive in their geological characters, both above and below these beds with plants, have enabled us to fix definitely the relative Geological age of this *Rajmahal* group. This is Oolitic, and of the later portion of the upper Oolitic period of Europe. But the true coal-bearing rocks are entirely below these Rajmahal beds, are separated from them by a distinct unconformity, and by the intervention of another thick series, distinguished by plant remains of a totally different character. So far from their being marked by a prevalence of Cycadaceous forms, as frequently stated, I do not know of the occurrence of a single cycad in the coal-rocks of India. There is in abundance and forming indeed

the distinctive fossil, a *Glossopteris (G. Browniana)*, identical in its typical form and in all the varieties with the same fern, which occurs abundantly in the Australian coal, and which is there stated to be intercalated with true marine fossils of undoubted Carboniferous age. But this Glossopteris was hastily and rashly asserted to be a well-known oolitic form, and on this assertion was based the statement that all the Australian coal also was oolitic. I pointed out, more than 10 years since, that no true *Glossopteris* had ever been found save in Australia or India, and that therefore any such assertions as to the Geological age indicated by it in Europe were baseless. With these Glossopteris remains, however, there occurs a large number of fossil plants belonging to a genus first recognized in the sandstones of the Vosges Mountains, *Schizoneura*. And, further, in the group which immediately succeeds the coal-rocks in India, and which has been called the *Panchet* series, occur remains of Dicynodont and of Labyrinthodont character, which, so far as they go, tend to fix the age of these beds. They are apparently Triassic in their relations, and it follows therefore that the underlying coal-rocks cannot be younger than the Permian of Europe, while they are very possibly older. Indeed, I see nothing to alter the opinion announced ten years since, that the coal-bearing rocks of India probably represent in part the time, which in most parts of Europe is indicated by the marked break in succession which occurs at top of the Permian series, with a large portion of the older period also, as represented by the great thickness of the lower beds of this plant-bearing series.

'We have hitherto spoken of what may be called the true coal-rocks. In addition to these, there are in several places—chiefly in the northern portion of the country, in the outer Himalaya, and in the minor ranges skirting these—small deposits, often merely nests, of lignite and lignitic coal, of little value commercially. Towards the East, in Assam and in the Khasi Hills, these lignites assume a greater importance and form thick beds, with tolerable continuity, of finely mineralized coal of much purity, and capital gas-producing quality. Unfortunately they occur in localities comparatively inaccessible,

and have not as yet been economized, excepting for purely local objects. The Geological age of all these deposits appears to be nearly the same, namely, at the close of the Cretaceous and commencement of the Eocene.'

The communication was illustrated by a geological map of India, and maps of some of the separate coal-fields.

REPORT OF SECTIONS FOR 1873.

Astronomical Section.

Report on the Temple Observatory, 1873.

The instruments at present attached to this Observatory are:—

The Alvan Clark Equatorial, 8¼-in. dia. and 110-in. focus.
With Reflector, 12¼-in. dia.
Refractor given by Ormerod, 3½-in. dia.
Reflector and Spectroscope for Nebulae, 15-in. dia. and 45-in. focus.
Large Spectroscope for Sun work, and ring slit arrangement.
Micrometer, Sextant, Theodolite.
Heliostat, Sprengel air-pump and tubes, Dawes' solar eyepiece, &c.

These instruments are all in good order, and have been used for instruction.

The Observatory itself is in need of some substantial repair or reconstruction.

The chief work has been the measurement of double and multiple stars, 430 of which have been observed during the past year. Many of them are stars which have not been examined for many years, and a systematic re-examination of such stars is being undertaken, with the view of forming as complete a list as possible of binary systems in which motion is recognizable.

Mr. Percy Smith, F. C. Houghton, W. Larden, and L. Maxwell, are most conspicuous amongst those who have assisted Mr. Wilson and Mr. Seabroke in this work.

The orbit of Σ 1938 has been calculated by Mr. Wilson by means of Herschel's and Thiele's methods, which give a period of 200 years. The orbit of this star had been previously calculated by Hind, but the data had proved to be inaccurate, and the star was departing from the position laid down in its ephemeris.

Mr. Wilson has also given a new solution of the problem of finding the real from the apparent orbit of a double star, by a method purely graphical. These results are published in the monthly notices of the Astronomical Society.

In June, photographs of the moon were taken by H. N. and J. R. Hutchinson, with fair results.

The sun has been observed and drawings of the chromosphere made

on 86 days by Mr. Seabroke, and a most decided aggregation of prominences on either side of the equatorial regions is perceived in the drawings, and these are just the regions most frequented by spots, shewing a decided connection between the two phenomena. A paper on the results of these observations has been published in the monthly notices.

Experiments have been made by Mr. Seabroke to determine the heat and light radiating-powers of gases at low pressures when excited by the electric current, which tend to shew that the elementary gases give more light in proportion to heat than the compounds.

It has also been shewn that a continuous current of electricity can be maintained between a piece of coke and a platinum plate immersed in nitric acid; the quantity of electricity is, however, small. It is probable that the coke becomes oxidized in the place of the zinc, used in other batteries.

A few drawings of the planets have been made during the year, and in part by members of the School.

The following presents have been made to the Observatory:—

Radcliffe observations for 1870 by Trustees of Radcliffe Observatory.
Plates published by Harward Observatory, by Mr. Wilson.

The number of visitors to the Observatory who made use of the instruments was 380.

During the Lent Term a course of Lectures on Astronomy were given by Mr. Wilson and Mr. Seabroke. They were attended by about 60, some of whom were members of the School, and an examination at the end was passed by many with credit. Mr. Lockyer presented prizes to the two first, W. Larden and Miss M. Moberly.

The Telescope and Observatory were formally presented to the Governing Body of Rugby School by Mr. Wilson on April 30th, 1873. The following is an extract from the reply of the Chairman of the Governing Body, the Lord Bishop of Worcester:—

'*May* 23*rd*, 1873.

'My Dear Mr. Wilson,

'I communicated your letter of April 30th to the Governing Body of Rugby School. . . . The Governing Body accept with pleasure and gratitude your offer of the Temple Telescope for the use of the School; and they desire me to express to you their sense of the value of your gift, and their best thanks for it. They will not fail in forming plans for new buildings to make arrangements for a suitable and permanent site for it. The question of the appointment of a Curator of the Telescope, and of an annual report of the work done in connection with it, will not be lost sight of in framing the regulations of the School. . . .

'Yours faithfully,

(Signed) 'H. Worcester.'

A small silver plate is affixed to the stone pedestal on which the Telescope rests, with the following inscription:—

HOC PERSPICILLUM
IN USUM DAWESII AB ALVANO CLARK ELABORATUM
SCHOLÆ RUGBEIENSI
QUO CŒLI MIRACULA EXPLORENT,
SCIENTIAM AUGEANT, EXERCEANT INGENIA,
IN DEI GLORIAM
FREDERICO TEMPLE AUCTORE
D.D.
J. M. WILSON
A.D. MDCCCLXXI.

Meteorological Section.

The meteorological observations have been continued during the year, Mr. Kirk having been good enough to take them during the holidays.

There is, of course, some little difficulty arising from the frequent change of observers amongst the boys, as new observers are apt to make slips now and then. Precautions, however, are taken as far as possible to detect an error at once.

The barometer appears to be the most popular instrument, and as there are generally two or three fresh candidates to undertake it at our usual monthly meetings, it is frequently arranged that one boy reads it for the first half of the month and another for the second. In this way each gets his turn.

There have been eighteen observers from the School during the year, the same number as last year.

Their names are given below.

As before, the readings were reduced for temperature and sea level, and the averages computed by Mr. Wilson, with the assistance of some of the observers.

H. O. Arnold
R. S. Gunnery
F. T. S. Houghton
H. N. Hutchinson
T. F. Johnson
G. L. King
L. Maxwell
J. W. Nicholson
H. F. Newall
R. D. Oldham
P. R. Page Henderson
J. H. Patry
A. J. Solly
C. G. Steel
F. Swanzy
V. L. Tapling
B. R. Wise
E. T. Wise

It is worth while to call attention to the remarkably low readings of the barometers on the 19th and 20th of January, 1873. They are given below, corrected for temperature and sea level.

Jan. 19th,	8.30 A.M.	....28·803
	11.0 P.M.	....28·384
Jan. 20th,	8.30 A.M.	....28·515
	9.0 P.M.	....28·377

The morning readings were those of the School barometer, taken by Mr. Kirk. Those in the evening were taken by myself from my own instrument, a standard by Casella. The actual reading at 9 P.M., on the 20th, was 28·020, which, corrected for temperature only (44° F.), becomes 27·981, and agrees closely with the reading of a compensated Aneroid.

Mr. E. J. Lowe stated in the *Times* that his lowest reading (at Nottingham) was at 11.30 P.M. on the 19th, 28·373 (corrected and reduced).

Mr. G. J. Symons gave the lowest readings recorded since January, 1857 (Camden Square, London), as follows:—

1859, ...	Dec. 26th,	6.0 A.M.	....28·629
1866, ...	Feb. 11th,	4.30 P.M.	....28·606
1872, ...	Jan. 24th,	4.47 A.M.	....28·332
1873, ...	Jan. 20th,	10.0 A.M.	....28·447

T. N. HUTCHINSON.

The following certificate has been received from Kew Observatory:—

Sensitive Minimum Thermometer for Grass, *No.* 17,519, *by Casella, London.*

(VERIFIED UNMOUNTED AND IN A VERTICAL POSITION.)

Corrections to be applied to the scale readings, determined by comparison with the standard instruments at the Kew Observatory.

At 32°	— 0·0
42°	— 0·1
52°	— 0·2
62°	— 0·0
72°	— 0·1

Note 1.—When the sign of the correction is +, the quantity is to be *added* to the observed scale reading, and when — to be *subtracted* from it.

Note 2.—As alcohol wets the capillary glass tube and is very volatile, this instrument ought occasionally to be examined in order to ascertain that there is no liquid above the main column. If there should be some condensed in the top of the tube, by slightly heating this it will be driven down so as to join the main column.

SAMUEL JEFFERY, *Superintendent.*

Kew Observatory, March, 1873.

Meteorological Observations.

January.

Date	Barom. Reduced	Temperature Dry Bulb	Wet Bulb	Max.	Mi[illegible]	Dry Bulb	Wet Bulb	Max.	Min.	Rain — Inches
1		39,8	39	[illegible]	3	35	34	[illegible]	[illegible]	,24
2	29,418	44,8	43	48,2	3	[illegible]	38	49,2	35	,17
3	29,640	46	44	[illegible]	3	[illegible]	[illegible]	[illegible]	30	,15
4	29,849	41	[illegible]	47,8	3	30	29	35,4	25	,10
5	29,733	[illegible]	38	53,2	3	35,4	35	39	30	,03
6	29,950	48,2	46	[illegible]	3	33	[illegible]	44,8	31	,02
7	30,090	[illegible]	44	50	4	36,6	36	41	32	
8	29,759	[illegible]	[illegible]	[illegible]	4	25	25	[illegible]	24	,01
9	29,655	[illegible]	[illegible]	50,4	4	37	35	40	25	
10	29,630	48,8	47	[illegible]	4	32	32	[illegible]	31,6	
11	29,789	49	[illegible]	53	4	29,8	27,6	[illegible]	28	
12	29,874	[illegible]	43,8	53	4	31	29	36	28	
13	29,926	46,8	45,8	49,2	3	32,8	31	32,8	29	
14	30,106	49,8	48	52	4	33,4	33	[illegible]	32	
15	30,017	44,6	44,4	53	4					Total
16	30,046	47,6	45	48	4	39,5				1,62
17	30,021	37	36	[illegible]	3					

February.

Date	Barom.	Dry	Max.	Min.	Rain	Date	Barom.	Dry Bulb	Wet Bulb	Max.	Min.	Rain
1	30,149	3	39,1	30	,10	17	30,679	[illegible]	32,2	37,5	[illegible]	
2	29,661	2	29,2	24,1	,10	18	30,786	27,1	26,2	36	25	
3	29,684	2	30,1	25	,17	19	30,732	[illegible]	30	32,2	[illegible]	
4	30,024	3	30,1	25	,14	20	30,614	26	26	35	25,5	
5	30,167	3	34,0	[illegible]	,14	21	30,386	29	29	43,4	25,5	
6	30,095	3	34,6	32		22	29,883	33,5	33	33,5	28	
7	30,189	3	34,7	31,1		23	29,902	29,8	[illegible]	42	22	,01
8		3	36,0	32,8	,01	24	29,847	26	25	36	[illegible]	,16
9	30,288	3	35,3	[illegible]	,03	25	29,649	[illegible]	31	31,2	[illegible]	,08
10	30,245	3	[illegible]	31,6	,04	26	28,875	44	43,5	44,8	30,2	,15
11	30,476	3	43,3	29,2		27	29.849	36,8	36,0	49,5	36	
12	30,132	3	37,6	30,2		28	29,764	29,5	28,0	41	28	,01
13	30,265	3	41,5	30,2								Total
14	30,285	3	43,8	[illegible]		Average	30,115	32,55				1,14
15	30,445	3	[illegible]	33,6								
[illegible]	[illegible]	3	45,5	35,5								

March.

Date	Barom.	Dry Bulb	Wet Bulb	Max.	Min.	Rain	Date	Barom.	Dry Bulb	Wet Bulb	Max.	Min.	Rain
1	29,372	32,5	32,1	44	28,0	,23	18	29,809	36,5	35,5	41,4	35,5	,00
2	29,552	38,0	36,0	44,0	32,2	,10	19	29,995	36,8	[illegible]	43,5	35	,00
3	29,810	[illegible]	38,0	40,8	35,5	[illegible]	20	30,073	[illegible]	35	43,8	35	,08
4	29,734	46,6	46	48,5	38	[illegible]	21	30,019	[illegible]	35,4	42	[illegible]	,20
5	29,806	40,5	40,2	50	37	,06	22	30,011	34,0	[illegible]	37,2	29	,02
6	30,049	35,5	35,2	49,8	[illegible]	,16	23	[illegible]	39,5	[illegible]	47,4	32	,04
7	29,249	43,5	42,5	46,0	35,5	[illegible]	24	30,103	[illegible]	38,4	[illegible]	37,8	,01
8	29,585	39,0	[illegible]	47,5	34	,07	25	30,191	48,8	[illegible]	55,4	37	,00
9	29,619	43,8	41,5	[illegible]	33,5	,07	26	[illegible]	[illegible]	34	[illegible]	[illegible]	,00
10	29,392	36,5	35,5	49,5	[illegible]	,08	[illegible]	30,128	37	[illegible]	[illegible]	33	,00
11	29,164	[illegible]	34,0	47,8	31	,05	28	[illegible]	37,5	37,3	[illegible]	32,5	,00
12	29,360	34,5	32,5	47	31,7	,00	29	30,017	37	37	62	[illegible]	,01
13	29,434	32,7	29,4	41	[illegible]	,27	30	[illegible]	46	44,5	[illegible]	36	,04
14	29,502	31,5	31,0	41	28,8	[illegible]	31	[illegible]	[illegible]	[illegible]	61,8	38,5	
15	29,953	34,4	33,8	35,4	30	[illegible]							Total
16	29,883	[illegible]	32,0	40,8	[illegible]	,29	Average	29,793	37,76				1,95
17		36,5	36	40	33,4	,00							

April.

Date	Barom. Reduced	Dry Bulb	Temperature Wet Bulb	Max.	Min.	Rain — Inches	Date	Barom. Reduced	Dry Bulb	Temperature Wet Bulb	Max.	Min.	Rain — Inches
1	29,927	46,6	43,8	54,5	37,4		18	29,762	46,2	45	64,2	42	
2	30,247	45	42,3	58,2	34,5		19	30,118	46	43	[illegible]	36	
3	30,211	46,9	45,5	59	36,5		20	30,211	51	46	62	33	
4	30,176	47	43,8	56,3	39,2	,33	21	[illegible]	44,8	42,2	65	[illegible]	
5	29,829	47,1	43,4	52	44,8		22	30,076	43,8	42	62,2	37	
6	29,655	45	40,3	52,9	38	,16	23	29,985	40	36,8	48	31,6	
7	29,893	40,4	38,2	50,5	36,8		24	29,967	38,8	34	45	29	
8	30,114	41,3	38,2	45,2	36		25	30,175	37	34	46	28,8	,02
9	30,337	42	38	51,6	37,3		26	30,295	38	34,6	46	28,2	,10
10	30,384	39,6	38	47	25,9		27	30,013	42	40	50,2	38	,01
11	30,166	42,7	41	54,8	34		28	30,159	48,8	45	58,5	37,4	
12	30,093	42,2	40	45,2	39,8		29	30,093	51	46,8	54	45	,01
13	30,016						30	30,218	50	47	54,6	39	
14	29,903	49,3	46,0	49,5	[illegible]								Total
15	29,729	60,2	53,2	60,2	55		Average	30,042	45,38				,80
16	29,631	55	52,4	73,2	55	,16							
17	29,599	46	45	70	45	,01							

May.

Date	Barom. Reduced	Dry Bulb	Wet Bulb	Max.	Min.	Rain Inches	Date	Barom. Reduced	Dry Bulb	Wet Bulb	Max.	Min.	Rain Inches
1	30,150	50,2	49	54	49		18	29,701	42,8	42,2	61	42,7	,03
2	30,028	54	48,2	62,8	37,4		19	29,985	[illegible]	[illegible]	43,8	38,7	
3	29,704	52,2	46	62,2	41,4	,11	20	30,328	47,4	42,3	53,1	[illegible]	,44
4	29,777	45	42	56,8	39	,30	21	30,074	46	45,3	59,8	49,3	,11
5	29,463	47,2	46,4	57,2	41	,42	22	29,952	53,8	51,9	54,5	45,1	,04
6	29,509	47,8	43,2	57,8	36,4	,04	23	29,700	[illegible]	53	[illegible]	47	,02
7	29,562	47,6	44	55	37,8	,10	24	30,089	50,4	45,1	[illegible]	[illegible]	
8	29,554	49	47	52,2	39	,03	25	30.286	56	50,1	60,8	38,5	
9	29,958	50,5	48,1	55,2	37,3	,09	26	29.994	54,5	49,3	63,1	47,8	,16
10	30,118	50,9	47,5	60,4	39,8	,01	27	29,807	52,1	50,6	60,7	43,5	,14
11	30,126	62,4	56,8	63,2	50,5		28	30,217	50,7	[illegible]	65,5	45,6	
12	30,208	54,4	51	65,7	44,3		29	30,414	51,8	47,5	62,3	39,8	
13	,0,203	51	44,9	68,2	35		30	30,309	49,2	44,1	63,2	34,2	
14	30,267	43,1	39,2	60,2	34		31	30,204	50,1	46,5	63,1	26,5	0,17
15	30,140	46,2	42,9	55,1	34								Total
16	30,027	45,3	42	58,5	33.9		Average	29,987	49,7				2,63
17	29,734	46,6	44	61	37,1	,32							

June.

Date	Barom. Reduced	Dry Bulb	Wet Bulb	Max.	Min.	Rain Inches	Date	Barom. Reduced	Dry Bulb	Wet Bulb	Max.	Min.	Rain Inches
1	29,972	49,5	49	66	44	,01			57,8	54,9	69	49,4	
2	30.153	51,2	48,6	54,3	42	,03			58,8	55,1		53,3	
3	29,916	50,2	50	64,8	42	,09			59,6	56,1		54	
4	29,886			72	45	,62			63,9	61		55,4	
5	29,851	58,9	58,4	79,2	56	,21			66,1	64		60	,01
6	30.079	51,5	50,4	61	50				59,5	55,4		50,1	
7	[illegible]	51,8	48,1	58	41,8				57,1	54,5		45,9	
8	30,212	61	57,8	65,8	49,9				55,9	52		44,3	
9	[illegible]	59,1	59	65	48,3	,18							,01
10	29.782	52	50,5	54,9	48,5				62,2	59		54	
11	29.689	53,2	51,2	68,3	50,2	,07			58,6	55,2		54,2	
12	29,596	54,1	50,9	59	47	,03			65	59,8		48,7	1,43
13	29,602	57,2	56,8	68,2	48,3	,89			55	54,3		55	,01
14	29,765	55,5	58,2	64,6	49	,04							Total
15	29,833	58,9	55	65	49,3	,01			57,27				3,64
16	29,951	57,2	57,2	67,9	45,7								
17	30,018	62,9	56,6	68,8	49,5								

July.

Date	Barom. Reduced	Temperature Dry Bulb	Wet Bulb	Max.	Min.	Rain — Inches	Date	Barom. Reduced	Temperature Dry Bulb	Wet Bulb	Max.	Min.	Rain — Inches
1	30,003	55,2	59,8	68	53,7		18	29,894	59	57,5	68	57	
2	30,026	62,1	57,6	68,8	52	,02	19	30,166	58,5	57	66,2	44	
3	29,901	59,6	57,8	67	57	,23	20	30,129	64,5	61	65,2	53,5	
4	29,713	57,5	53,8	62	51,8	,03	21	30,187	71	67	78,5	56	
5	29,840	53,8	53	65,8	46,2	,11	22	30,048	75,5	69	82,8	61	,02
6	29,854	58	53,8	65,6	53,2		23	29,922	70	68	88,2	65	,01
7	30,100	61,6	56	69	46,2		24	30,044	68,2	56,8	81,5	55,2	
8	30,102	63,6	57,2	73	50,5		25	29,995	65,8	61	70	58,5	,32
9	30,141	59	55	75,5	49		26	29,939	59,5	57	71,2	56,5	
10	29,873	60,6	58	69,2	53,8		27	29,956	59,8	55,8	70,5	52	,11
11	29,850	59,8	55	71,2	51		28	30,006	61,8	58	68	57,8	,21
12	29,759	57,5	54,8	64,6	48	,16	29	29,964	65	60,8	68	42,5	,04
13	29,683	57,5	54,2	69,4	47	,73	30	30,058	66,5	59,5	73	57,8	,07
14	29,667	57,8	55	63,2	46	,03	31	30,058	69,5	62,8	73,2	57,5	
15	29,743	56,5	53	68	49	,09	Average						Total
16	30,045	58	53,8	64,5	49			29,737	61,7				2,27
17	30,072	60,5	58,5	69	52	,09							

August.

Date	Barom. Reduced	Dry Bulb	Wet Bulb	Max.	Min.	Rain Inches	Date	Barom. Reduced	Dry Bulb	Wet Bulb	Max.	Min.	Rain Inches
1	30,052	59	56	72	56,4	0,05	18	29,807	56	54	66,2	52,4	
2	30,177	63	57	64,8	57,2		19	29,581	53,4	53	62,4	52	0,40
3	30,126	61	58	70,4	53,6		20	29,764	59	54,6	63,8	49	0,05
4	30,159	54,6	53	71	47,2	0,01	21	29,772	56,8	55,2	59	49,8	0,27
5	29,946	63	59	66,4	54	0,04	22	29,843	61	57	68,6	50,6	
6	29,891	62,6	58,8	73	56,6		23	29,895	60,4	57,2	69,2	48,8	
7	30,088	66,8	63,8	69,2	60		24	29,892	61	60	70	55,8	0,06
8	30,012	65	62	81	55		25	29,883	64,8	62,6	72,8	57	0,19
9	29,892	58	53	79	51	0,02	26	29,853	62	58	76,6	55	
10	30,273	59	52,8	64	48		27	29,884	60,6	57	71	53	0,21
11	29,947	55,4	54,2	65,4	51,8	0,10	28	29,512	59,8	54,2	68,4	54	0,08
12	30,038	63	60	64	53,2	0,03	29	29,658	48,8	47	60	46,4	0,27
13	29,818	64	59	72	59	0,15	30	29,734	57,6	54	61,2	47,8	0,15
14	30,064	62	57	71	53		31	29,848	57	56	67	52,8	0,12
15	30,042	62,8	61	72,8	55,8	0,01	Average						Total
16	29,974	62	60	72,4	59,8			29,925	59,9				2,21
17	30,171	59	53	71	49								

September.

Date	Barom. Reduced	Dry Bulb	Wet Bulb	Max.	Min.	Rain Inches	Date	Barom. Reduced	Dry Bulb	Wet Bulb	Max.	Min.	Rain Inches
1	29,730	60,4	59,8	66,2	57	0,15	18	29,854	52	48,8	67,4	46	
2	29,751	55	52	65	51	0,04	19	30,108	49,8	47	62	44,8	0,01
3	29,979	53	51,4	59	45	0,16	20	30,040	60	58	60,4	49	0,01
4	30,067	52,8	52	63,4	46		21	30,243	54	51	65,8	51,4	
5	30,123	51	48	59	46		22	30,551	49	46	59	36,8	
6	30,008	51,2	47	58	43,6	0,05	23	30,466	48,8	46,8	61	39,8	
7	29,783	51	48	56	43,8	0,05	24	30,371	52,4	49,2	65	42	
8	29,799	49	68	57	38	0,03	25	30,287	52	50	68	49	
9	29,757	55	53,2	62,2	43	0.20	26	30,178	54	52	65,2	41	
10	29,610	54,8	51	58,4	50,2	0,11	27	29,991	55,2	52,2	69	43	
11	29,812	54,8	52	64	50		28	29,912	58	56	72,4	48,8	
12	29,856	55,6	52,2	64	46,8		29	30,251	43	41	59	31	
13	29,880	53	50	64,8	41	0,16	30	30,209	49,8	47	61,8	39,8	
14	29,597	54	52	60	46	0,03	Average						Total
15	29,233	52,2	49	61,6	47,2	0,27		29,661	52,9				1,28
16	29,642	51,2	47	60,4	44	0,01							
17	29,666	55,2	54,8	60,2	43,8								

October.

1	29,123	43,1	41,8	52,4	40,5		18	30,420	39,4	39,1	42,2	38,6	,01
2	29,289	37,2	36,0	51,4	33,5	,14	19	30,163	41,0	40,5	46,2	38,0	
3	29,427	36,9	36,7	45,0	35,0	,01	20	30,173	40,0	39,2	45,5	38,5	
4	29,568	38,5	37,6	51,5	31,0	,02	21	30,044	33,0	32,5	43,5	32,0	,08
5	29,450	45,0	44,6	50,0	37,6	,10	22	29.406	50,8	46,5	52,5	32,0	
6	29,327	45,8	45,0	49,0	41,6	,63	23	29,594	51,8	48,0	56,0	46,0	
7	29,512	43,5	43,0	46,8	[illegible]	,20	24	29,879	48,4	41,2	51,8	[illegible]	
8	29,982	45,0	44,2	47,2	43,0	,03	25	30,167	50.8	48,5	[illegible]	34,0	
9	30,131	42,5	40,6	45,2	41,0	,14	26	29,878	51,4	51,2	51,4	37,0	,16
10	30,158	43	42,0	46,5	37,5	,15	27	29,413	43,2	41,0	53,5	41,0	
11	30,316	38,1	37,2	43,2	37,0		28	29,929	42,5	40,2	[illegible]	40,0	
12	30,131	38,8	38,0	47,0	33,2		29	29,783	51,5	49,3	52,5	42,0	,05
13	29,914	26,8	26,4	46,8	25,2		30	29,873	43,2	40,3	[illegible]	40,2	,01
14	30,014	36,8	31,1	40,0	26,0								Total
15	30,386	40,4	33,2	43,0	33,0		Average	29,878	42,2			25,2	1,63
16	30,494	38,0	36,5	49,2	30,0								
17	30,510	40,2	39,0	42,5	35,2								

December.

1	30,462	40	39	46,8	34,5		18	30,162	48	46,2	53	46	
2	30,507	46,6	46	48	39		19	30,015	46	45,2	50,6	42,8	0,20
3	30,596	46,5	45,5	55,8	46		20	29,936	36	36	48	36,4	0,01
4	30,623	40	39	47	36		21	30,119	44,6	43	47	36	0,03
5	30,445	41	40	44	39		22	30,000	43,6	43	48	43	
6	30,423						23	30,129	39,6	38	46	36	0,01
7	30,552					0,1	24	30,204	46	44	50	44	
8	30,581	43	41,4	44	38,5		25	30,314	40,4	40	48,2	37	
9	30,588	34,6	31,2	45,2	33,6		26	30,122	41	40	46	40	0,16
10	30.571	24,8	24,8	46,8	24,6		27	29,811	36	36	45	35,8	0,01
11	30,652	21,2	21,2	41,4	20		28	30,222	25,6	25	41	25	
12	30,692	20	20	41	19		29	30,051	30,8	30	30,8	25,4	
13	30,657	29,8	29,2	32,4	25		30	29,845	2	30,2	39	31	0,06
14	30,499	30,4	30,2	37,2	27		31	29,517	42,4	41,8	46,2	38	
15	30,181	35	34	55	30	0,03							Total
16	29,791	54	52	54	35	0,01	Average	30,271	38,0				0,61
17	30,139	48,8	48	56	40								

Entomological Section.

There have been a few additions made to the Rugby list during the past year. They are not extensive; partly on account of the bad summer and partly on account of the great scarcity of real working members in this Section. The best species added to our local list this year was Orgyia Gonostigma, taken by A. J. Solly.

Additions to the Local List.

Dicranura bifida	Noctua plecta
Orgyia Gonostigma	Cidaria dilaceata
Euperia Fulvago	

Only five new species, and those not at all striking, seem to constitute the whole result of the work of this Section for a year.

The absence of Mr. Sidgwick from England prevents our obtaining from him the record of his observations last year.

H. VICARS.

Botanical Section.

A special report of the observations made by this Section will be printed next Term.

Considerable progress has been made with a collection of local plants in a form accessible to all.

The following have assisted the President in this work—

R. A. Fayrer	V. H. Veley
G. L. King	E. T. Wise
H. W. Trott	

E. T. WISE.

Zoological Section.

List of Notices.

Rook's nest begun in 'Three Trees'	Feb. 14	
Blackbird's nest, (with eggs)	April 3	R. Cunliffe
Cuckoo heard on Dunchurch Road	May 3	C. M. Chadwick
Missel Thrush's nest, (three eggs)	May 3	F. Sykes
Chiff-Chaff, (one egg)	May 4	H. H. Child
Green Linnet, (hard set)	May 4	R. Cunliffe
Hedge-Sparrow, (with eggs)	May 4	C. M. Chadwick
Thrushes and Blackbirds, (full fledged)	May 6	C. M. Chadwick
Goldfinch, (two eggs)	May 10	R. Cunliffe
Corncrake heard at Newbold	May 11	C. M. Chadwick
Rooks, (on the wing), at Rainsbrook	May 15	H. H. Child
Moorhen, (one egg)	May 15	R. Cunliffe
Sedgewarbler, (with eggs)	May 15	R. Cunliffe
Black-headed Bunting, (with eggs)	May 17	R. Cunliffe
Swifts observed	May 19	W. B. Lowe

Yellowhammer, (eggs)	May 19	C. M. Chadwick
Starlings, (with half-fledged young)	May 20	C. M. Chadwick
Chaffinch, (hard set)	May 24	C. M. Chadwick
Skylark, (hard set)	May 25	H. H. Child
Kingfisher, (4 young, nearly fledged)	May 25	J. Ravenscroft
Reedwarbler, (eggs)	May 29	C. M. Chadwick
Woodpigeon, (hard set)	June 16	R. Cunliffe

C. M. CHADWICK.

The egg cabinet has now been replaced in the Society's room. It is trusted to the care of every Member of the Society. It is desired to form a complete collection of well authenticated Rugby eggs, as well as a general British collection. Contributions towards either collection will be received by

B. R. WISE.

Geological Section.

The Oolitic Drift at Brownsover, May 24, 1873.

The diagrams (Plate iii.) are intended to represent three sections, at right angles to one another, of the stratified oolitic drift on the southern side of Brownsover Hill. To quote from a Paper of Mr. Wilson's in the Report for 1871, "This deposit is about 300 yds. to your left when you have passed through four gates on the road from Brownsover to St. Thomas' Cross. It is an excavation in a sloping field, and exhibits a section of stratified oolitic drift, sloping at various angles. There are belts of sand in it, and everything indicates a shore deposit." . . . "It appears to me to be a portion of an old sea beach, probably formed under the ice-foot in the glacial age."

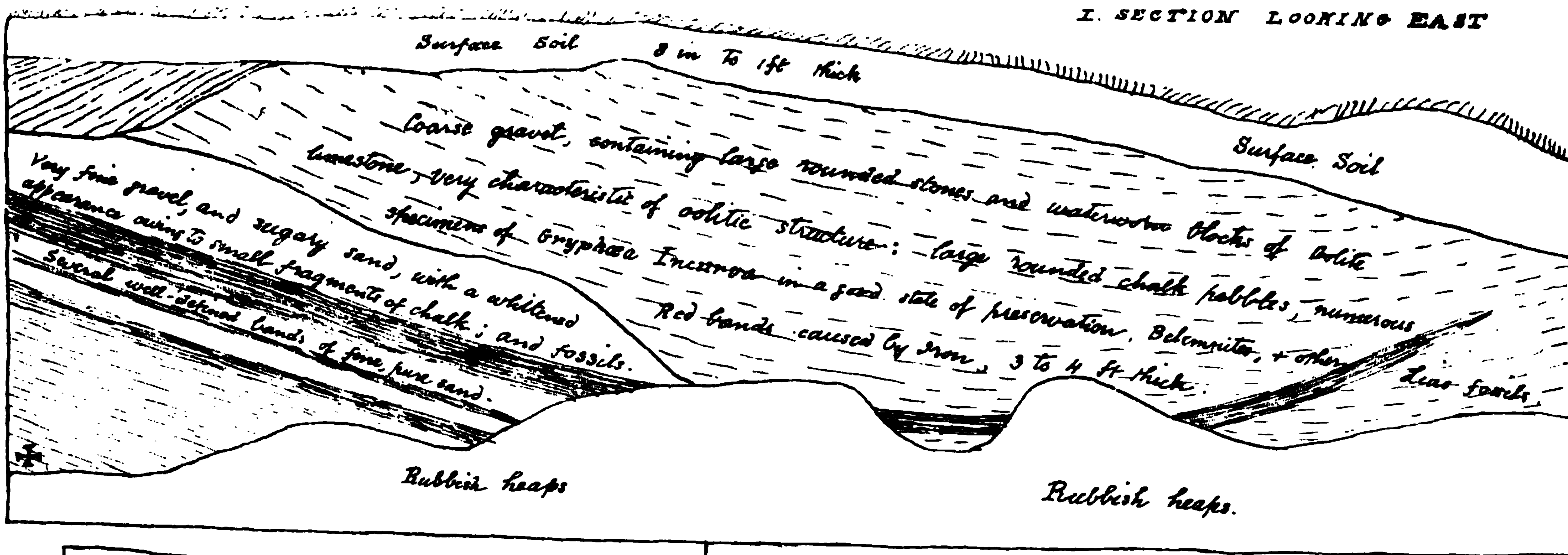
Section I. is the most important. It is about 10 or 11 feet high, the upper part of which consists of coarse oolitic gravel drift; and the lower part of fine gravel, sugary sand, with several well and sharply marked belts of pure sand. One of these (B, Fig. I.) was seen suddenly to thin out and terminate, as shown at the right hand side of the diagram; which seems to show that such belts of sand are only local, and extend over limited areas.

The whole seemed to be stratified rather in the shape of a basin, though conforming to the slope of the hill southwards.

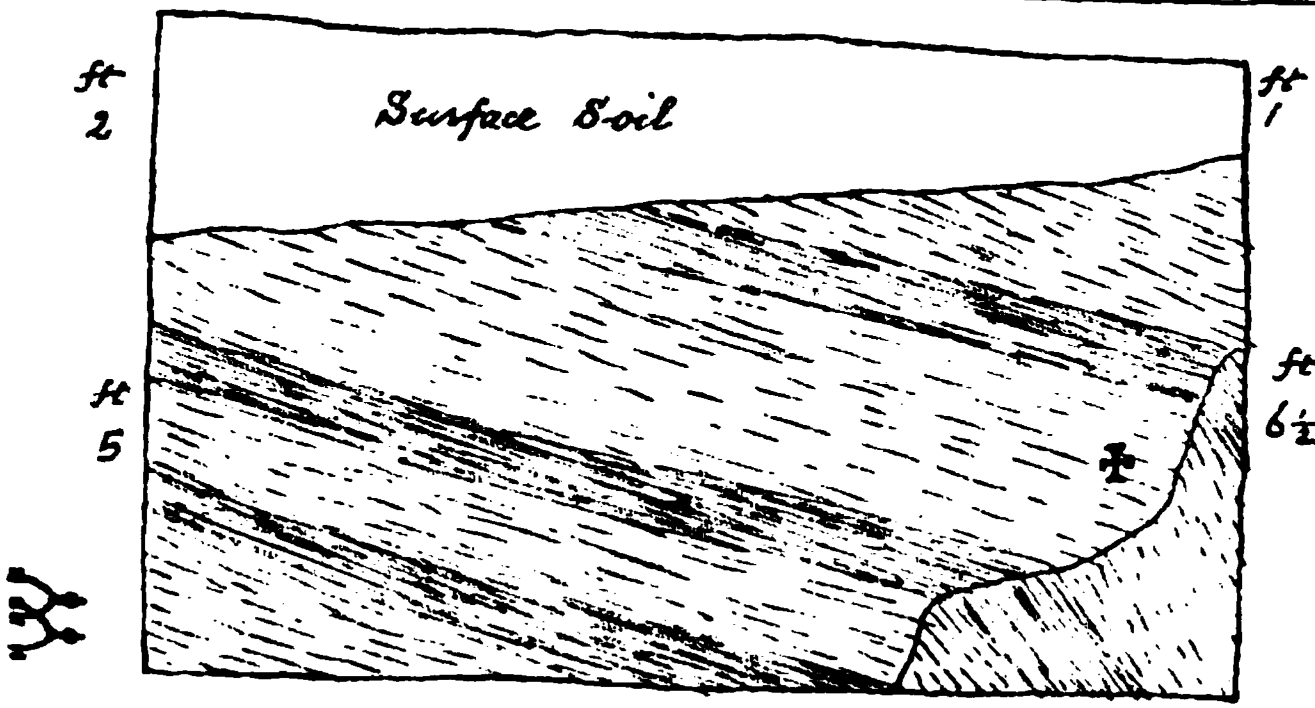
Lias fossils were very numerous, especially "*Gryphoea Incurva,*" in good preservation. An entire Ammonite (Communis ?) and numerous fragments, much waterworn, were found; also, portions of other shells, numerous Belemnites, and what looked like red chalk.

The parts in the different sections marked with a cross are different parts of one belt of fine gravel and sand, which, it will be seen, is higher at the west than at the east, and as the faces of sections I. and III. are only about 15 yds. apart, this shows that the drift has a considerable dip to the east; the general dip being about S.E.

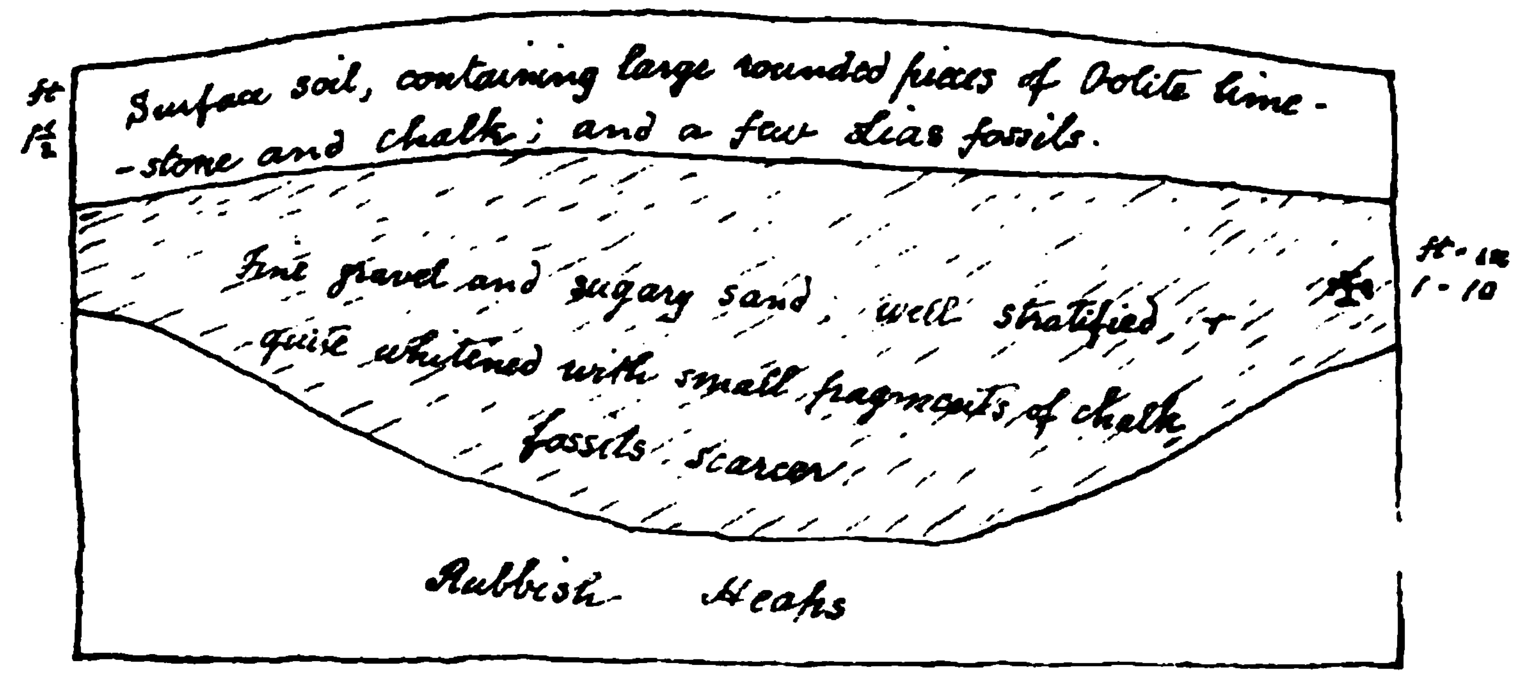
PLATE III



I. SECTION LOOKING EAST



II. SECTION LOOKING NORTH



III. SECTION LOOKING WEST

The measurements may be relied upon.

The three dark bands in Fig. II. are belts of coarse gravel reddened by the presence of iron, and containing concretionary lumps and flat pieces of iron-stone.

Section of the Drift on the slope of the hill to the north of the Bilton Road, just above the Bilton Clay-pit, May 31, 1873.

Surface soil, ½ foot.

Mottled clay, containing striated chalk pebbles, sandstone pebbles, oolitic pebbles (?), and rounded quartzose pebbles, 1 foot 8 inches.

Yellowish brown sand, imperfectly stratified, 7 inches.

Reddish sand, without any pebbles, 4 feet 9 inches.

Layer of brownish-red clay, with small pebbles, about 1 inch.

Yellowish-red sugary sand, to unknown depth.

Section at the Clay-pit, Bilton Road, May 31, 1873.

Red sand, with pebbles of sandstone and quartzite, 3 feet 6 inches.

Light-blue clay, with a layer of limestone about 4 feet from its surface, and several thin bands of yellow concretionary nodules, 10 feet.

Dark blue clay, with a very irregular surface, to unknown depth.

The Drift as exposed at the Victoria Works, New Bilton, May 31, 1873.

Coarse, earthy, brown sand; containing rounded and angular pebbles of quartzite, coarse sandstone and fine sandstone, pure flint, white quartz, and a light, hardish white stone, full of small cavities and brown specks, but apparently no chalk: some of the rounded stones of considerable size.

Estimated percentage of stones and pebbles, by inspection, 15 to 20 per cent.

Section of the Drift at the New Bilton Clay-pits, June 5, 1873.

The total thickness of the drift seems to be nearly 10 feet. It contains some very large blocks of sandstone, rounded, some as large as a man's head. A band through it consists almost entirely of pebbles and stones of quartzite, sandstone, and slate: but in some parts gradually merged into the surrounding sand and gravel. The gravel here seems to be very like, or identical with, that which is exposed at a small cutting made in the roadside on the Lawford Road, about half-way to New Bilton. The drift there exposed is a coarse, earthy, brown sand, containing a large proportion of gravel and pebbles of quartz, quartzite, sandstone, and flint: it has quite a whitened appearance, with small pebbles, and fragments of white quartz. It seemed to be imperfectly stratified, with thin bands of fine sand.

The estimated percentage of stones and pebbles is 30 to 40 per cent.

L. Maxwell.

LIST OF BOOKS, PAPERS, MAPS, &c., ON THE GEOLOGY, MINERALOGY, AND PALAEONTOLOGY OF WARWICKSHIRE.

BY WILLIAM WHITAKER, B.A., (LOND.), OF THE GEOLOGICAL SURVEY OF ENGLAND.
COMMUNICATED BY MR. WILSON.

Index of Authors, with the Numbers of their Papers, &c.

The following list contains the titles of Papers, &c., by 63 different authors chronologically arranged, from old descriptions of mineral waters down to the more strictly Geological notes of 1873.

List of Works.

1685.

1. DERHAM, S. Hydrologia philosophica; or an Account of Ilmington Waters in Warwickshire. *8vo. Oxon.*

1699.

2. ALLEN, B. - The Natural History of the Chalybeat and Purging Waters of England........ *8vo. Lond.*

1740.

3. SHORT, DR. T. An Essay Towards a Natural, Experimental, and Medicinal History of the Principal Mineral Waters of........Warwickshire, &c....... *4to. Sheffield.*

1798.

4. LAMBE, W. - An Analysis of the Waters of two Mineral Springs at Lemington Priors, near Warwick; including Experiments tending to elucidate the Origin of the Muriatic Acid. *Phil. Mag., vol.* i. *pp.* 255, 350.

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6. DALTON, S. - (Extraordinary Bones found at Rugby.) *Monthly Mag., vol.* xxxiv. *No.* 234, *p.* 407.

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9. BUCKLAND, REV.[DR.]W. Description of the Quartz Rock of the Lickey Hill in Worcestershire, and of the Strata immediately surrounding it; with considerations on the evidences of a Recent Deluge afforded by the gravel beds of

Warwickshire and Oxfordshire, &c. *Trans. Geol. Soc., vol.* v. *p.* 506.

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12. GRIMES, R. - Observations on the Flints of Warwickshire (Roy. Soc.). *Edin. Journ. of Sci., vol.* iii. *p.* 77.

1827.

13. YATES, REV. J. Observations on the Structure of the Border Country of Salop and North Wales; and of some detached Groups of Transition Rocks in the Midland Counties. (Warwick, *p.* 258.) *Trans. Geol. Soc., ser.* 2, *vol.* ii. *p.* 237.

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14. CUMBERLAND, G. Some Account of the Order in which the Fossil Saurians were discovered. *Quart. Journ. of Sci., Lit. and Art, p.* 345.

15. JUKES, F. - An Account of a new Species of Trilobite, found in the Barr Limestone in the Neighbourhood of Birmingham; with a Note by J. D. C. SOWERBY. *Mag. Nat. Hist., vol.* ii. *p.* 41.

16. ———— Notice of some Fragments of Orthoceras annularis and striata, found in the Barr Limestone in Warwickshire; with a Note by J. D. C. SOWERBY. *Ibid, p.* 231.

17. PHILLIPS, R. On a new Compound of Oxygen and Manganese; with Remarks on Dr. Turner's Memoir on the Oxides of that Metal. *Phil. Mag., ser.* 2, *vol.* v. *p.* 209.

18. ———— On the Oxides of Manganese. *Ibid, vol.* vi. *p.* 281.

19. TURNER, PROF. E. Remarks on Mr. Phillips' Essay on Manganese. *Ibid, vol.* v. *p.* 254.

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21. SHARPE, D. - Description of a New Species of Ichthyosaurus. *Proc. Geol. Soc., vol.* i. *p.* 221.

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26. MURCHISON, [SIR] R. I. On an outlying basin of Lias on the borders of Salop and Cheshire, with a short account of the lower Lias between Gloucester and Worcester. *Proc. Geol. Soc., vol.* ii. *p.* 114.

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29. GOOCH, T. L. Account of a Toad found alive imbedded in a Solid Mass of New Red Sandstone. *Rep. Brit. Assoc. for* 1835, *Trans. of Sections, p.* 72.

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36. MURCHISON, [SIR] R. I. and H. E. STRICKLAND. On the Upper Formations of the New Red Sandstone System in Gloucestershire, Worcestershire, and Warwickshire ...... with some account of the underlying sandstone of Ombersley, Bromsgrove, and Warwick...... *Trans. Geol. Soc., ser.* 2, *vol.* v., *p.* 331.

37. STRICKLAND, H. E. On the occurrence of a Fossil Dragon-fly in the Lias of Warwickshire. *Mag. Nat. Hist., ser.* 2, *vol.* iv., *p.* 301.

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41. ———— On the Teeth of Species of the Genus Labyrinthodon common to the German Keuper formation and the Lower Sandstone of Warwick and Leamington. *Trans. Geol. Soc., ser.* 2, *vol.* vi., *p.* 503.

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44. DAWES, J. S. On the Occurrence of Vegetable Remains, supposed to be Marine, in the New Red Sandstone. *Rep. Brit. Assoc. for* 1842, *Trans. of Sections, p.* 47.

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45. **Brodie, Rev. P. B., and [Prof.] J. Buckman.** On the Stonesfield Slate of the Cotteswold Hills. *Proc. Geol. Soc., vol.* iv., *p.* 437, and *Quart. Journ. Geol. Soc., vol.* i., *p.* 220.

46. **Dawes, J. S.** Remarks upon Sternbergiæ. *Ibid, pp.* 359 *and* 91 *respectively.*

47. **Strickland, H. E.** On certain Calcareo-corneous Bodies found in the outer chambers of Ammonites. *Ibid, p.* 449, *and Ibid, p.* 230.

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49. **Buckman, Prof. J.** On some Fossil Plants from the Lias. *Quart. Journ. Geol. Soc., vol.* vi., *p.* 413.

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52, 53. **Howell, H. H.** Sheets 54, S. E. and S. W. of the *Geological Survey Map.*

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60. **Evershed, H.** Farming of Warwickshire (with account of soils, &c.) *Journ. Roy. Agric. Soc., vol.* xvii., *p.* 475.

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66. BRODIE, REV. P. B. On some Species of Corals in the Lias of Gloucestershire, Worcestershire, Warwickshire, and Scotland [Brit. Assoc.] *Ibid, vol.* v., *p.* 260.

67. ———— Remarks on the Lias of Barrow in Leicestershire, compared with the lower part of that Formation in Gloucestershire, Worcestershire, and Warwickshire. *Ann. and Mag. Nat. Hist., ser.* 2, *vol.* xx., *p.* 190, and *Proc. Cotteswold Nat. Club, vol.* ii., *p.* 139.

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70. ANON. - - Note on the Warwickshire Coal-field. 22*nd Ann. Rep. Warwick Nat. Hist. and Archaeol. Soc., p.* 6.

71. EGERTON, SIR P. DE M. G. Palichthyologic Notes. No. 10. On Palæoniscus superstes. With a "Note on the occurrence of a New Species of Fish in the Upper Keuper Sandstone in Warwickshire" by the REV. P. BRODIE. *Quart. Journ. Geol. Soc., vol.* xiv., *p.* 164.

72,73,74. HOWELL, H. H. Sheets 49, 50 (part) and 51 (part) of the Horizontal Sections of the *Geological Survey.*

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75. BAUERMAN, H., and T. R. POLWHELE. Sheet 45 N. W. (N. W. corner) of the *Geological Survey Map.*

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82. WRIGHT, DR. T. On the Zone of Avicula contorta, and the Lower Lias of the South of England. *Quart. Journ. Geol. Soc., vol.* xvi., *p.* 374.

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84. ———— On the Discovery of an ancient Hammer-head in certain Superficial Deposits near Coventry. *Edin. New Phil. Journ., ser.* 2, *vol.* xiv., *p.* 62.

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86. SYMONDS, REV. W. S. On some Phenomena connected with the Drifts of the Severn, Avon, Wye, and Usk. *Edin. New Phil. Journ., ser.* 2, *vol.* xiv., p. 281, and *Rep. Brit. Assoc. for* 1861, *Trans. of Sections, p.* 133 (1862).

87. WRIGHT, DR. T. A Monograph on the British Fossil Echinodermata, from the Oolitic Formations. Part Fourth, containing the Echimolampidae, the Stratigraphical Distribution of the Echinodermata, &c., (Warwick, pp. 457—459, 462). *Palæontograph. Soc., 4to. Lond.*

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93. PERCY, DR. J. Metallurgy (Vol. 2). Iron and Steel. (Analysis of Warwickshire Ore, p. 217.) *8vo. Lond.*

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94. BRODIE, REV. P. B. Excursion to Fenny Compton, &c. *Proc. Warwick Nat. and Archaeol. Field Club, p.* 6.

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which characterize them. *Proc. Warwick Nat. and Archaeol. Field Club, p.* 1, and (with a shorter title) in *Trans. Woolhope Nat. Field Club for* 1866, *p.* 205, and *Trans. Dudley and Midland Geol. and Sci. Soc.*

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113. BRUCE, A. C. On the accurate Division of the Local Lias at Rugby into Zones, by their Fossils, more especially by their Ammonites. *Rep. Rugby School Nat. Hist. Soc. for* 1868, *p.* 19.

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116. SMITH, T. MC. D. Account of the Rugby Well. Report by the Engineer (Metrop. Board of Works) on the Boring Operations at Crossness Pumping Station. Revised to Feb. 8. 8*vo. Lond.*

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119. ANON. - (Meetings at Bromsgrove and Lutterworth.) *Proc. Warwick Nat. and Archaeol. Field Club, pp.* 24, 31. [See also 35*th Ann. Rep. Warwick Nat. Hist. and Archaeol. Soc., pp.* 25, 27. (1871.)]

120. BRODIE, REV. P. B. On the Geology of Warwickshire. *34th Ann. Rep. Warwick Nat. and Archaeol. Soc., p.* 10.

121. HUXLEY, PROF. T. H. On the Classification of the Dinosauria, with Observations on the Dinosauria of the Trias. *Quart. Journ. Geol. Soc., vol.* xxvi. *p.* 32.

122. LLOYD, T. G. B. On the Superficial Deposits of Portions of the Avon and Severn Valleys and adjoining Districts. *Ibid, p.* 202.

123. MUSGRAVE, R. M. On the drift Gravel of Lutterworth, Kilworth, &c. *Proc. Warwick Nat. and Archaeol. Field Club, pp.* 11, 23.

124. WILSON, J. M. On the Surface-deposits in the Neighbourhood of Rugby. *Quart. Journ. Geol. Soc., vol.* xxvi. *p.* 192.

125. ———— On the Drifts and Gravels and Alluvial Soils of Rugby and its Neighbourhood. *Rep. Rugby School Nat. Hist. Soc. for* 1869, *p.* 16.

126. WOOD, S. V., JUN. Observations on the Sequence of the Glacial Beds. *Geol. Mag., vol.* vii. p. 17.

1871.

127. ARMITAGE, J. Localities [of fossils] new to the List. *Rep. Rugby School Nat. Hist. Soc. for* 1870, *p.* 45.

128. - - - Report of the Commissioners appointed to inquire into the several matters relating to Coal in the United Kingdom. Vol. i. General Report, &c.—Report of Committee D........the probability of finding Coal under the Permian, &c........ Vol. ii. General Minutes and Proceedings of Committees. Warwickshire, p. 388, &c. *fol. Lond.*

1872.

129. ANON. - Excursion to Warwickshire. *Proc. Geol. Assoc., vol.* ii. *No.* 7, *p.* 284.

130. WILSON, J. M. Note on a Boulder lately discovered in Cosford Valley and a Conglomerate Boulder in Brownsover. *Rep. Rugby School Nat. Hist. Soc. for* 1871, *p.* 19.

131. ———— Note on a newly-discovered Oolitic Drift at Brownsover. *Ibid, p.* 20.

132. ———— Catalogue of Local Fossils in the Museum. *Ibid, p.* 55.

[We are greatly indebted to the compiler of this valuable list for the permission to print it, and shall be much obliged to any correspondents who will supplement and complete it, if there should chance to be any omissions in it.—ED.]

W. BILLINGTON, PRINTER, RUGBY.

REPORT

OF

THE RUGBY SCHOOL

NATURAL HISTORY SOCIETY

FOR THE YEAR

1874.

"IIS QUIBUS NON CONJICERE ET HARIOLARI SED INVENIRE ET SCIRE PROPOSITUM EST, OMNIA A REBUS IPSIS PETENDA SUNT."

—BACON.

RUGBY: W. BILLINGTON.
1875.

PREFACE.

We enter this year on a new epoch of our existence, not without many regrets and some fears: for we have to-day to bid adieu to Mr. Kitchener, to whose energy and kindness we owe not merely our existence as a Society, but whatever success or efficiency we may have achieved. Eight years have now elapsed since the memorable 23rd of March, 1867, when we first saw the light in a little room in New Street. It is obvious that the loss we sustain in the removal of our Founder is one which nothing can exactly supply: and we shall content ourselves therefore with a few general remarks upon our present condition, feeling that the best return we can make to Mr. Kitchener for all he has done for us, is to do our utmost to keep up and develope the usefulness of a Society in which he has taken so much interest and which owes everything to him.

Our Sectional Reports are on the whole satisfactory, though from various causes it is difficult to keep the work as systematic as is requisite for real success.

The Society has worked hard at the Model of the Rugby District, and has made considerable progress.

The Observatory has done really valuable and important work: and perhaps the Society may claim some very humble share in this.

The Geological Section continue their patient researches, and have made this year, as usual, some real additions to our local knowledge.

The Botanical Section do not make much appearance in our Report; but they have devoted a great deal of pains and time to the preparation of a local list, which at the last moment cannot be published owing to the issue of a new London Catologue with the numbers entirely altered. As these numbers are essential in our list for reference, the Section will withhold their list till next year, when they will have included one more year's observations, and have had time to alter the reference numbers in accordance with the new catalogue.

The Meteorological Section continue their useful record of barometer, thermometers, and rainfall, portions of which are printed as usual.

The Entomological Section have done little but arrange their cabinet. This is a useful work, undoubtedly, and has cost some pains: but we hope next year in this department to have some more systematic observations to record. They have revised the

local list up to date: but there is much to be done here in verifying and extending it. One associate has volunteered to study the Coleoptera (beetles): such special work is much needed, and we wish him success.

We are glad to observe that a very large proportion of the Papers read has been the work of actual members and associates; and to a great extent the result of individual research and observation. This is the true test of the Society being in a healthy state; and we trust that in this point it will maintain its standard.

One instance of energy among the members deserves a special word of thanks from the Society. We had arranged to insert as Plate 3 a heliotype of some Compound Pendulum curves, drawn by H. F. Newall (M), with a machine constructed by himself. After page 1 of our Report (containing the promise of the plate) was printed off, we discovered to our mortification that the magenta ink in which they were drawn would not photograph, and accordingly the heliotype was impossible. We were relieved from our dilemma by Mr. Newall, who set his machine to work and has drawn the whole of the 300 plates, (containing 900 curves,) himself. Every member of the Society is thus enabled to have an actual specimen of the work of this ingenious machine: which is far more satisfactory than any heliotype would be.

A. Sidgwick.
G. L. King.
H. N. Hutchinson.
H. Vicars.

April, 1875.

ERRATUM.

In the Temperature Report for December, (p. 45) the maximum column is wanting, and that printed as max. is really the *minimum reading*, that printed as min. is really the *minimum on grass*, which is not usually entered in these records.

ACCOUNTS FOR 1874.

Cr.	£.	s.	d.		£.	s.	d. Dr.
Balance, see last Report	8	4	10	Plates, printing	2	7	9
Members' Subscriptions	12	0	0	Books and Periodicals	6	3	8
Sale of Keys and Old Reports	0	4	0	Prize	2	0	0
				Cabinet for Eggs, &c.	2	18	0
				Stamps and parcels	0	4	1
					13	13	6
				Balance carried forward	6	15	4
	£20	8	10		£20	8	10

ADDRESSES.

Anastatic Printing, and Materials: Mr. Cowell, Buttermarket, Ipswich.
Heliotype Printing: Messrs. Gilbert and Rivington, Lincoln Terrace, Kilburn, N.W.

RULES.

I.

That this Society be called "THE RUGBY SCHOOL NATURAL HISTORY SOCIETY."

II.

That the Society consist of Honorary Members, Corresponding Members, Members, and Associates.

III.

That Masters, and others connected with the School, or any Benefactor of the Society, be eligible as Honorary, and Old Rugbeians as Corresponding Members; that Present Rugbeians be eligible as Members, or Associates.

Of Officers:

IV.

That the Society's Officers consist of a President, Secretary, and Curator, and of the Keepers of the several Albums, and that these do form the Committee of Management, three to be a quorum.

V.

That all Officers be elected annually.

VI.

That when any office is vacant, the Committee do recommend a Member or Associate, or (for the office of President) an Honorary Member, for election by the Members of the Society, and that the election be by scrutiny.

VII.

That the President take the chair at all Meetings, but have no vote except in cases of equality.

VIII.

That the Secretary keep the Minutes of the Society's proceedings; keep a list of the existing Society, with the names and addresses, as far as possible, of all Corresponding Members, and a list of all Benefactors of the Society.

IX.

That the President and Curator form a Sub-Committee, for managing the finances and keeping the property of the Society.

X.

That the duty of the several Album Keepers be to call together Sectional Meetings; to receive all notices connected with their several Sections; to enter all occurrences of interest in their Album; and at the end of each year to furnish a Report of what has been done in their Section during the year.

XI.

That in the absence of any Officer, the Committee appoint a Deputy.

Of Honorary and Corresponding Members:

XII.

That Honorary Members be elected by open vote of the Society; pay an entrance fee of 10s. but no subscription unless specially called upon; and have all the privileges of Members, except that of voting: but that Benefactors of the Society who are elected Honorary Members be excused the entrance fee.

XIII.

That Corresponding Members be elected by open vote of the Society, without entrance fee, and have all the privileges of Members, except that of voting; but do not receive the Society's Reports without payment, for a supply of which they may pay a composition.

Of Members and Associates:

XIV.

That Members and Associates be proposed by a Member or Honorary Member, and elected by the Committee.

XV.

That the number of Members be limited to fifteen.

XVI.

That no one become a Member or Associate without either paying a composition of 10s., or bringing a note to the President signed by his Tutor to allow a charge of 2s. 6d. per Term to be made in his bill.

XVII.

That Members may speak at all Meetings of the Society; may read Papers with the leave of the President; may introduce four Visitors at all Public* Meetings, and receive a copy of the Society's Report.

XVIII.

That Associates have the same privileges as Members, except the right of voting at Private Business Meetings.

XIX.

That any Member who in the course of the year shall not have read a Paper before the Society, shall require re-election by the Committee.

XX.

That any Member or Associate may be suspended or expelled from the Society by a vote of two-thirds of the Members present, if he, from any misdemeanour, or want of energy, appear to deserve such suspension or expulsion: but such a motion cannot be proposed again during the same Term after it has once been voted upon in a Meeting at which four-fifths of the Members then in residence have been present.

Of Meetings:

XXI.

That Ordinary Meetings be held once a fortnight, but that the Secretary be empowered to call Extraordinary Meetings when necessary.

XXII.

That Visitors may speak and read Papers at all Public Meetings, with the leave of the President.

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* It having appeared that Members and Associates have introduced other persons not belonging to the Society into the Society's room, it is necessary to state that this practice is not permitted by the rules.

Of Reports:

XXIII.

That a Report be printed once a year, or oftener if the Committee think fit.

XXIV.

That an Editing Committee, of two Members and one Honorary Member, be appointed by the President for each Report.

Of New Rules:

XXV.

That, without notice given at the preceding Meeting, no change can be voted in these Rules, or any vote of Suspension or Expulsion passed.

XXVI.

That no change be made in these Rules, unless proposed by a Member or Honorary Member, and carried by the votes of two-thirds of the Members present.

XXVII.

That in all cases where one vote be wanting to make up a majority of two-thirds of the Members present, the President be allowed to vote.

PRIZES.

The Society gives a Prize (at present £2 to the first, and £1 if a second is adjudged) for an Essay on any subject connected with Natural History. The Prize is decided by a Committee of 2 Honorary and 2 Ordinary Members elected at the first meeting of the October Term. The Essays should be sent in to the President (anonymously) the second Saturday in the October Term, with a sealed envelope, containing the author's name. Preference is given to original work of any kind as compared with matter compiled from books or papers.

Former Winners of the Prize.

1871. 1. H. Ricardo, on *Eyes and No Eyes.*
2. F. R. Hodgson, on *Pets.*

1872. 1. L. Maxwell, on *Spectrum Analysis.*
2. H. N. Hutchinson, on *Motive Power.*

1873. 1. Not awarded.
2. L. Knowles, on *Coal.*
V. H. Veley, on *Cross Fertilization.*

1874. 1. V. H. Veley, on *Symmetry in Flowers.*

LIST OF THE SOCIETY, LENT TERM, 1875.

Officers:

President: MR. A. SIDGWICK
Secretary: H. N. HUTCHINSON
Curator: H. VICARS
Editors: THE PRESIDENT, G. L. KING, H. VICARS, H. N. HUTCHINSON
Album Keepers: Botanical, H. W. TROTT
" " Geological, R. D. OLDHAM
" " Entomological, H. VICARS
" " Zoological, B. R. WISE

Honorary Members:

REV. DR. JEX-BLAKE
REV. T. N. HUTCHINSON, F.C.S.
MR. F. E. KITCHENER, F.L.S.
MR. J. M. WILSON, F.G.S., F.R.A.S.
REV. C. ELSEE
REV. C. E. MOBERLY
MR. C. DUKES, B. Sc.
MR. PERCY SMITH, F.C.S.
MR. H. T. GILLSON

Corresponding Members:

LORD BISHOP OF EXETER
G. F. Helm, M.D.
E. P. Knubley
W. C. Marshall
W. C. Eyton
T. G. B. Lloyd, F.G.S.
J. R. Dakyns, H.M. Geological Survey
C. L. Rothera, B. Sc.
F. W. Fison, F.C.S.
C. S. Taylor
E. Cleminshaw
G. B. Longstaff, F.C.S.
J. S. Masterman
H. C. L. Reader
F. C. Selous
J. H. Davies
R. E. Baynes
F. R. Smith
E. W. Prevost, D. Ph., F.C.S.
J. M. Lester
H. N. Larden
H. W. Eve, F.C.S.
N. Masterman
F. Bayard
S. Haslam
J. S. Alexander, H. M. Indian Geol. Survey
B. E. Hammond
G. M. Seabroke
Rev. A. Bloxam
F. C. Bayard
Rev. J. Robertson
R. Farquharson, M.D.
G. H. Morrell
C. T. Clough
C. Hinton
E. Burchardt
A. S. Napier
R. H. Ker
A. G. Burchardt
R. H. Scott, F.R.S.
W. B. Lowe
Rev. C. J. E. Smith
F. W. Spurling

[In the Report Members are marked (M) and Associates (A).]
Those marked *(n)* have become Associates by note: see rule 16.

Members:

E. T. Wise
B. R. Wise
H. N. Hutchinson
F. W. Dutton
H. Vicars
G. L. King
H. W. Trott
A. J. Solly
L. Knowles
V. H. Veley
E. J. Power
R. D. Oldham
H. F. Wilson
H. F. Newall

Associates:

W. H. Cross *(n)*
W. A. Sparrow *(n)*
H. B. Hemming
W. H. Prichard *(n)*
T. B. Eden *(n)*
C. H. Sargant
A. Duff *(n)*
S. Crosse
G. De S. Hamilton
A. Pearson
A. Ward *(n)*
M. V. Hilton
W. J. Napier
E. Inglis
S. King
W. S. Benyon-Winsor *(n)*
W. Abraham
G. A. Solly
F. Hutchinson *(n)*
C. A. James *(n)*
H. Hurrell
R. H. B. Bolton
G. Varley
D. P. Kingsford
H. L. Baggallay
C. M. Cunliffe
T. A. Wise
W. B. Thornhill
J. Y. Johnson
H. W. Fowler
H. Willis
M. J. Michael
H. Symonds
H. V. Armour
W. Calvert (*n*)
H. J. Davis (*n*)
C. Bayley
W. F. Hawtrey (*n*)
A. C. Bannister
A. C. Sandeman
C. Lund
J. Fayrer
G. H. Hodgson
R. S. Gunnery
D. C. Plumb (*n*)
G. W. Carleton
T. B. Oldham
J. C. Hurle
F. E. D. Hickman
R. Wever (*n*)
F. Willoughby (*n*)
R. A. Hughes
D. A. Hamilton
J. E. Marsh
W. Browett (*n*)

LIST OF PERSONS AND SOCIETIES AND JOURNALS TO WHICH COPIES OF REPORT ARE SENT.

Those marked * exchange Reports with us.

The Headmaster
The Chairman of Governing Body
The Bishop of Exeter
Professor H. J. S. Smith, Oxford
Professor Newton
Rev. A. Bloxam, Harboro' Magna
Rev. A. H. Wratislaw, Bury
Rev. J. Robertson, Harrow
R. H. Scott, Esq., Meteorological Office
G. J. Symons, Esq., 62, Camden Square
Nature
Geological Magazine
Jermyn Street Museum
Astronomical Society
Linnean Society
Geological Society
Radcliffe Observer, Oxford
Oxford Union
Cambridge Union
*King Edward's School, Birmingham
*Clifton College, N.H.S.
*Marlborough " "
*Wellington " "
*Cheltenham " "
*Winchester " "
*Warwickshire "
Leicester Philosophical Society
*Birmingham Society
*Bristol Society
College, Wellington, New Zealand

LIST OF PERIODICALS TAKEN BY THE SOCIETY,

AND KEPT IN THE SOCIETY'S ROOM.

Land and Water
The English Mechanic and World of Science
The Journal of Botany
The Entomologist
Science Gossip is kindly placed in the Society's Room by Rev. T. N. Hutchinson

LIST OF PAPERS.

Those marked * are by Members of the School.

REPORTS.

STATISTICS, &c.

† The First List of Bench Marks is to be found in our Report for 1868, copies of which can still be had for 6d. on application to the President.

MINUTES OF MEETINGS.

PRIVATE BUSINESS MEETINGS were held Jan. 31, May 2, Sept. 29.

MEETING HELD FEB. 7. (16 present).

Donation: two boxes of eggs, by J. R. Hutchinson.

Exhibitions: Specimens of iron ore collected by Mr. Pinfold of Rugby, from a mine in Somersetshire, by G. M. Seabroke.

A series of curves drawn on paper by a Compound Pendulum, constructed by H. F. Newall (M). [An account of the machine will be found in the Minutes of Meeting, Feb. 21]. Some of these curves are copied on Plate 3.

Specimens of glass engraved by 'sand blast,' exhibited by Rev. T. N. Hutchinson, who explained the process as follows:—

'Sand is blown with great force through an orifice. If a piece of glass be held over this, a hole will soon be cut through it by the sand. The glass however may be protected in certain parts, and thus patterns engraved by allowing the sand to attack the unprotected part. Brass plates are used to protect the glass; but even varnish and lace are sufficient. It is still more remarkable that even the extremely thin coat of silver on a photographic plate suffices to protect the glass against the sand blast, so that the sand thus can etch the photographic design on the surface of the glass.'

Paper: An interesting Paper was then read on '*Diamonds*,' by V. H. Veley (M). The following points were dwelt upon:—

The principal diamond fields of the world: the difficulty of recognising uncut diamonds: the defects of certain diamonds: the use of diamonds, especially in recent years for rock-boring machines.

The Rev. T. N. Hutchinson gave an account of the attempts of French chemists to produce diamonds artificially: and explained the relation of the various crystalline forms in which the diamonds occur.

MEETING HELD FEB. 21. (43 present).

The reports of the Meteorological Section and the Temple Observatory for 1873 were read. [These will be found at the end of our Report].

Exhibitions: Ladd's Diffraction Spectroscope, by Rev. T. N. Hutchinson. In this instrument the fine lines, instead of being ruled on the glass, are photographed.

A Compound Pendulum, by H. F. Newall (A). The instrument which he had constructed himself, may be described as follows:— (See Plate 4, to which the letters refer).

'This machine, called by its inventor Mr. Tisley, "the Compound Pendulum Machine," consists of two pendulums, PP, with moveable weights, AA, vibrating (on knife edges BB, fastened to the pendulums), at right angles to one another. The pendulums are produced about 5 inches above the point of suspension, making the total length about 2 ft. 6 in., and to the top of each is fastened a rod, DD, (about 9 in. long), by means of a universal joint, CC, that is, a ball-and-socket joint, or one which admits of both horizontal and vertical movement. These rods are joined by a common hinge, at E, thus forming a right angle when the pendulums are at rest. As near the hinge as possible is fixed a pen which rests on a table about 4 in. high, which is placed upon the large table on the edge of which the pendulums rest. On the small table is fixed a card or bit of paper, and on it, when the pendulums are set in motion, the pen describes figures according to the relative rates of vibration of the pendulums. The rates are altered by moving the weights, and the pendulums are graduated, so that the simple proportions are easily got.'

The Rev. T. N. Hutchinson made a few remarks on this machine: he related the story of its invention, and illustrated it by the phenomena of sound-waves meeting at right angles. Similar curves may be seen traced in the air by a knitting needle, fixed in a vice, and vibrated by two blows at right angles to each other.

Paper: Mr. Wilson then read the following Paper on the '*Construction of a Geological Model of the Country round Rugby.*'

'There is, I believe, no piece of work which a society like ours could take up which would better repay our labour than the con-

struction of a model of the surface of the country round Rugby. A few such models already exist, and others are in progress, but it will be very long before our country is modelled by the Geological Survey. Our physical geography is not sufficiently striking to attract their attention, and they are sure to visit many other places first.

'The use of such a model is to present at once to the eye a mass of information about hills, and valleys, and slopes, and plains, that cannot be grasped by the inspection of maps and columns of figures of elevations. By this means it enables any one to judge of the causes which have operated on the surface, and made it what it now is, far better than in any other way. It combines the results of many geological walks. It would therefore be a contribution of real value to the study of the physical geography of England. And though our country is not very exciting or sensational, though we have no precipices and canons, yet we are not one dead flat, and if we can help towards solving the problem of the formation of our river valleys, we shall help in the problem which is the key to the structure of the surface of all England.

'Further, a model is not only a model of form, but a geological model. After the form is made true, the surface can be painted so as to mark the boundaries of the different drifts and alluvium. This would be a work that would take us several years to accomplish, and a model would be a receptacle for a vast number of isolated observations which are now lost for want of any such receptacle.

'By the use of numbers the depth in feet of the drifts could be indicated, and thus valuable information could be given to the well-sinker and builder.

'The position of boulders might easily be indicated, and thus furnish information as to the routes these erratics have followed. A work of this kind was undertaken by a local Swiss Society in commemoration of their 50th anniversary. Let us shew that we are as wise in 5 years as they were in 50.

'There can be no doubt at all about the value of the finished work. The only question is how to do it. And this question divides itself into three parts, on all of which I wish to ask the advice of the Society.

'First, as to the material to be used in modelling.

'On this I am very ignorant. Clay, wax, and plaster of Paris all suggest themselves, and I incline to the first: it is possible that I could get information from the Geological Survey as to the results of their experience.

'Secondly, as to the scale.

'I would suggest 6 inches to the mile for the horizontal scale, *i.e.* $\frac{1}{10560}$ of nature; and for the vertical scale 1 inch to 50 feet, or $\frac{1}{600}$ of nature. This would exaggerate the vertical scale 17 times, I am aware, and exaggerate all our slopes and hills, and yet without some such exaggeration I doubt whether the features of the country would admit of distinct representation. The total differences of level in our district would lie within 150 feet or thereabouts, so that

our hills would only be 3 inches high. Still it would have some advantages to reduce this scale even to one-half, and make one inch represent 100 feet vertical.

'Thirdly, the arrangements for doing the work.

'I would suggest, simply by way of starting the discussion, that we divide the country up into regions of 1 square mile each, and that volunteers be found to undertake a square mile, and prepare a preliminary model of it. For this purpose clay must be provided, and a set of frames, 6 inches square, made and numbered. An ordnance map cut up will furnish all the required information as to places and bearings; and the table of altitudes I furnished to the Society in the year 1868, and printed in Natural History Report for that year, will furnish much that is wanted in that line. Much however must be done by the eye, and then one square will have to be checked by its adjacent squares. When we get one part done, say 16 squares of which Rugby is one corner, then we can proceed to make a model of the combination in plaster, and proceed with the geological colouring, &c., and another generation will no doubt take up another 16 squares, and so on. Thus it will be seen that I aim at getting a final model of 64 square miles, of which Rugby is the centre, and the greatest distance which any member of the Rugby School Natural History Society will be required to walk in surveying for such a model is $4\sqrt{2}$ or about $5\frac{1}{2}$ miles.

'I think the work would be interesting, and of great value; and I very heartily commend it to you. I will undertake a square, and of course help in every way I can. But it is an *opus magnum*, and I could not undertake it by myself. How many volunteers are ready?'

MEETING HELD MARCH 7. (44 present).

Donation: The original photographs of the Gigantic Cuttle-fish caught off Newfoundland, with an account from the 'Field,' by T. G. B. Lloyd, (O.R.) F.G.S., through Mr. Wilson.

This animal is 8 feet long, with two arms 24 feet long, and eight more arms 6 feet long, each with a hundred suckers.

Exhibitions: Coal with veins of calc-spar, from Clifton Colliery, Nottingham; and a fine specimen of Dendritic Oxide of Manganese, from Anglesea; by Rev. T. N. Hutchinson.

An impression of parts of a small Labyrinthodon, on coal, from Ireland, by J. R. Allen, (O.R.), through Mr. Wilson. A drawing of this will be found on Plate 1.

Papers: The Rev. T. N. Hutchinson read a Paper on the '*Nautilus.*'

This described the two kinds, the Pearly and the Paper

Nautilus, and was illustrated by specimens of the shells, and diagrams shewing the structure and methods of locomotion, &c.

V. H. Veley (M) read a Paper on '*Precious Stones.*'

E. J. Power (M) read a Paper on '*Mounting Objects for the Microscope,*' of which the following were the chief points.

'Most objects, before they can be examined to perfection by the microscope, require some previous preparation. To convince the beginner of this let him take for instance the leg of a fly, and without having prepared it, place it under the microscope. What does he see? A black indistinct object, fringed with hairs, and half out of focus. But let him see it properly prepared, and that black limb is changed into a beautiful object, armed at the top with suckers and claws, and perfectly clear. Now to attain this result is by no means hard; all that is wanted is a small bottle of Canada balsam, camel's hair brushes, some needles bent into curves, and some finished off with a knob, glass slides, and thin glass. Having chosen your object, take a glass slide, and when quite clean place the object in the centre; take up some turpentine in a glass tube and drop a little on the object; then take a little balsam, and, having warmed it (and great care must be taken not to boil it), drop it on the object; then having warmed a piece of thin glass, drop it on the balsam; use *just* enough pressure to make the balsam go outside the edges of the glass; leave it thus two days, and then put more pressure on it, and then place it in a warm place to evaporate the turpentine. When it has hardened scrape off the surplus balsam with a knife, and finally wash it with turpentine and label it.

'Of the various parts of insects, *wings* are the easiest to prepare for the microscope, as no dissecting is required: all that is necessary is to soak them in potash, press them, and set them in balsam.

'*Legs* require more care, and must be soaked more thoroughly.

'Sections of *bone* want much attention. They have to be sawn off with a fine saw, in a quite thin slice, and then ground down to the requisite thickness for their structure to be visible. The grinding requires great accuracy.

'*Fruit-stones* also demand the utmost nicety. They must be prepared carefully and constantly watched with the microscope, until just one layer of cells is left and no more.

'*Tongues* must be laid out and dried. The bee's tongue and the fly's tongue are the most suitable, and are not hard to prepare.

'*Eyes* have to be carefully dissected, and usually are best in cells, a mode of preparation that will be explained in a moment. When they are properly prepared, their various facets, (as they are compound eyes), make them interesting objects.

'*Scales* of butterflies may be laid on dry and just covered with varnish.

'The cells are made as follows: a small circular daub of black is laid on the centre of the glass, with the aid of a turn-table. This daub of black, when dry, being raised a trifle above the glass, forms

a circular rim capable of containing a small drop of liquid, glycerine or alcohol, or whatever it may be. Into this diminutive tank is put the microscopic object, and a very thin piece of glass as big as half a postage-stamp is put over it and pressed down. It is a matter of some skill to avoid admitting any air bubbles when the drop of liquid is thus being imprisoned. The thin glass is then fastened down with another dab of the black, and the cell is complete.

'It may be mentioned that a variety of balsam containing benzine instead of turpentine is sometimes preferred.'

Mr. Wilson read the following note on the '*Companion of Sirius*.'

'I chanced a few nights ago to look at Sirius through the Temple Telescope. It was a calm, hazy, almost foggy night; and to my surprise I was able to see and measure the position and distance of its comes, which is considered a feat for a telescope of very large aperture. Mr. Seabroke also measured it, and our measures gave an angle of 65° and a distance of about 11". It may be interesting to shew what conclusions an observation like this leads to. This comes was discovered in 1863, and then the angle was 88°. It has therefore performed 23° of its revolution in 10 years.

'It is not possible yet to determine whether this portion is a fair or an exceptional specimen of its orbit, nor is it certain that these observations, which are very difficult, can be fully relied on; but if they are taken as true, and the orbit is not far from circular, it leads to the conclusion that the mass of Sirius is about 12 times that of the sun. This confirms in a rather remarkable way some previous conclusions about Sirius. It is more luminous than the sun, probably 200 times as luminous. Now if a body 12 times the mass of the sun, and therefore if of equal density with not much more than twice its radius, and about 5 times its surface, is nevertheless 200 times as luminous, it must be vastly brighter, and therefore probably hotter. But spectroscopic observation shews that it is much hotter than the sun, and therefore probably less dense also, thus entirely confirming these observations of a different nature.'

MEETING HELD MARCH 28. (53 present).

Donation: Box of Moths, by F. C. Woodforde, Esq.

Exhibitions: Two specimens of shells of the Pearly Nautilus, by L. Knowles. Geological specimens from Isle of Wight; granite from the Pyrenees; by J. M. Wilson.

The Rev. T. N. Hutchinson explained the arrangements of the Duplex Telegraph, by which messages can be sent at the same time by the same wire in opposite directions. The method was invented as far back as 1853, though only recently applied in practice; it is already working satisfactorily not only in England, but between

Lisbon and Malta on the submarine cable. The explanation was accompanied by experiments and a working model of the arrangement.

MEETING HELD MAY 16. (51 present).

Mr. Kitchener took leave of the Society, and Mr. Sidgwick took the chair.

Donations: Morris' British Moths, 4 vols.; by A. Sidgwick. Three earlier volumes of 'Land and Water'; by Capt. Wallerstein. An old glass bottle, with marine incrustations, from the Dogger Bank; by F. Hutchinson.

Exhibitions: 60 minerals from Vesuvius, by Mr. Wilson. Photographs of the moon, by G. M. Seabroke (O.R.), and H. N. Hutchinson (M). The latter then described the processes by which these photographs were taken and enlarged.

Mr. Kitchener then expressed his extreme regret that a nest of a spotted woodpecker in one of the trees on the island in the close, should have been destroyed by some mischievous person, causing the birds to desert the place.

Mr. Wilson exhibited the plaster cast of the first half of the Model of the country, explaining how the heights were taken by help of the aneroid barometer.

Paper: The Rev. T. N. Hutchinson then read a note on a '*mock-moon*'; which will be found in our Meteorological Report.

MEETING HELD MAY 30. (36 present).

The President read some correspondence with Mr. Bagnall, the Librarian of the Birmingham Natural History Society, about the mosses of Warwickshire, a Paper on which, by Mr. Bagnall, was presented to the Society.

Exhibitions: Anglo-Saxon iron spear-head from Borough Hill, Daventry; by L. Knowles (M). Geological specimens from the Lias and Gravel; by Mr. Wilson, and G. M. Seabroke (O.R.) A live grass-snake from Cambridge, by J. Y. Bostock (A).

Papers: V. H. Veley (M), read a Paper by R. A. Fayrer (A),

on the '*Mint*.' The Paper described the rolling, cutting, milling, stamping, &c. of the coins.

Mr. Seabroke mentioned *à propos* of this paper, the recent discoveries of Mr. Norman Lockyer, by which the spectroscope can detect not merely what are the ingredients of a compound, but also their proportional *quantities*. In this way alloy can be discovered to the extent of $\frac{1}{1000000}$th part, whereas by chemical analysis only $\frac{1}{10000}$th part can be detected.

E. J. Power (M) read a Paper on '*British Snakes*.' The Paper described the habits, food, and different markings and structure of the various kinds.

Some discussion was then raised about the attachment of rooks to particular trees, and the causes which lead the birds to select or desert them.

MEETING HELD JUNE 13. (16 present).

Exhibition: Nest of a warbler, from the river, containing five eggs and a cuckoo's egg; by P. H. Chapman.

Mr. Wilson communicated an account of the boring for water in 1862 by Mr. Hawkesley at the Rugby Waterworks. This Paper will be found at the end of our Report. A coloured plate, giving all the results of the boring down to a depth of 1140 feet, was printed in our Report for 1868.

Mr. Wilson also communicated a record of the rainfall in Rugby from 1855 to 1862 by Mr. Fuller. This will be found at the end of our Report.

H. F. Wilson (A), gave some notices of early appearances of insects.

Papers: Mr. Wilson read the following Paper on '*Contributions to the Geology of Hillmorton*.'

'I suppose there is no one here who does not know that there is something singular about the geology of Hillmorton. There is no place anywhere near Rugby where there are such sand pits as at the railway ballast pits and in Low Morton: there is no place where we can get better fossils in the clay pits; no other place in the neighbourhood where there are peat beds. Now an account of the geology of Hillmorton ought to include an accurate statement of facts with respect to these and similar phenomena; and to give some clear idea of the arrangement and disturbance of the strata

by which these phenomena have been produced. It is towards these objects that the present paper is intended as a small contribution.

'It will be necessary to refer to a plan of the village in order to make these remarks intelligible. (See Plate 6).

'In going to Low Morton by the lower road, we enter on sand, as is quite plain, when we cross the first brook marked A. We then go up a small hill, between high banks of sand, to the junction with the road to Clifton. The descent to the village of Low Morton is still between high and picturesque banks of sand; it is well shewn in one or two sections there; and is plainly stratified. We follow the main road into the village, then turn to the left up the little street past the school, and a large sand pit to our left, at the place marked C, catches our attention. It forms an amphitheatre, 47 feet deep, its walls nearly vertical, pierced with scores of holes made by the sand martins, who at this time of year make the place very lively. Quite close to the sand pit, at the top, is a clay pit, marked D, which is now disused. It is the ordinary lower lias clay. This is better seen now at E, the present brick works, where the geologist may soon pick up a few fossils, notably the hippopodium, gryphæa, pecten, arca, etc.

'We return down the village to the main street, and turn to the right, and see at our right, at F, grass grown cliffs, which on investigation are sand cliffs and banks; for here formerly were sand pits like those we have just left. The pumps in the village street tell us that water is to be got by wells; and on enquiry we learn that the wells are generally about 28 feet deep. This depth is bored or dug in dry sand, and below it there lies a quicksand or running sand, of very varying depth. Near the spot marked F it is not more than 1 foot thick, and is insufficient to supply the well with water: but a little further along the street either way it is much deeper; too deep to bore through. The lane at G that leads up to the Upper Hillmorton road shews the same high banks of sand that we saw before; and leaving them we go to the railway, and into the ballast pits. These are very extensive. They are bounded at H by a cliff, which shews about 10 feet of drift at the top, and then a steep slope of sand grown over with grass. The sand has been removed up to this cliff, and would have been removed further but that it would have involved widening the bridge of the railway over the road, so as to give a curve for the ballast train to get at it. At I some hillocks are seen in the pit, made of gravel. All this gravel has been shifted once or more times, as being worthless for ballast, and only removed in order to get at the sand below. Part of it comes from a terrace at J, where plainly the 10 feet of gravel has been removed, and there is left a flat surface, grass covered, the soil below being not exposed. Now I have good reason to believe that this is clay: and that it is bounded by a steep face towards the ballast pit. Years ago, but in the memory of some of the men still working there, an avalanche of sand came down that slope and buried their wagons: and after they had taken the trouble to remove all the gravel from the top, they found not sand below, but clay. And the terrace

remains, as a monument of the mistake. Just behind J, and between it and the windmill, trial holes were made to see whether sand was there, but all the holes shewed clay. At the windmill itself is a well 60 feet deep through clay, not sand. At K we can examine the sand very well. It is excavated there to a considerable depth below the line, and it has been shewn that the quicksand is below it, at the depth of only a few feet. The canal runs through sand here, and the slope on the opposite side of the valley through which the canal runs is also sand, as is plain to see. But the sand thins out in a hundred yards or so further on, and at the top of the hill at M it is gravel resting on clay.

'As we return by the road past the windmill we have the low ground to our left clay, and at first the field to our right is sand. But very soon it is gravel over clay on both sides of the road. At the junction to Kilsby there used to be a turnpike, and there the well was 40 feet deep in clay, covered by two or three feet of gravel, which thins out still further down the slope. Across the Kilsby road, part way down the slope at N, is an unfailing spring of water: doubtless the gravel on the top of the hill is an uneven surface of clay, and this is the point to which its hidden slopes conduct the water. The natural outflow of the water is about 10 yards from the corner, but the owner of the field has conducted it down by pipes to a pond placed at the bottom of the upper field, and available for the cattle in the lower field.

'As we return by the windmill towards the lower village, across the fields, we come across a deep pond at O, overshadowed by trees; the remains of an ancient marl or clay pit, from which marl was extracted for use on the lighter sandy soils: and at P is a gravel pit, where the gravel is seen to rest on sand. At Q is another old marl pit, now enclosed as a garden. At R, close to the new chapel, Mr. Lucas tried to establish clay pits, but in vain: it was not clay, but sand mixed with much lime and clay: and thus we complete our tour, and return to the village.

'But we are scarcely able to form any conclusions without looking a little further. So we go under the railway, and visit the churchyard. There we find unmistakeable peat in the ditches, and learn that an extensive peat bed, resting on quicksand, fills up the bed of the valley for a considerable distance, up nearly to the wharf. The sand is so wet as to be called a quicksand. The houses at the wharf, and the piers of the locks are built on concrete, a process of considerable difficulty. The depth of the sand is unknown. I caused a boring to be made at S, but it was stopped at 29 feet, further boring in the wet sand being impossible. Further down the valley, below the church, I made a similar boring 53 feet deep, with a similar result. This sand occupies the bed of the valley all the way down the stream, past Butler's leap, where I proved it to be 57 feet deep, and to rest on limestone rock, and even to the planks on the way to Brownsover, where it is only 7 feet thick, and rests on lias clay. This quicksand, both at the wharf and near Hillmorton church, caused much difficulty in the construction of the railway.

Everything sank in it; waggon loads of stones and bricks were swallowed up with no result, and finally faggots were used, and on these, I am told, inverted arches were constructed, and these bear the roadway.

'Now let us return to Hillmorton village.

'I think the facts above stated justify me in thinking it probable that a marked line of separation between clay and sand exists where I have drawn the dotted line on the map. I believe that along that line there exists a steep face of lias clay, against the north side of which rests sand, and that the gravel overspreads both alike, thinning out down the slopes. That this face or cliff of lias clay is steep, seems probable from the sand pit at C and clay pit at D being so close together, the sand pit being also so deep and so steep as to be almost overhung by the clay pit. And from the sudden and complete terminations of the sand in the ballast pits at J, one is obliged to draw the same conclusion. At the western corner of the sand pit the clay is only 5 feet below the bottom of the pit. Further away, by the school, there is no clay in the well which is 24 feet deep. The slope of the face of clay is not less than 40°.

'Now it occurs to me as possible that this cliff may be a true line of fault, to which it may be worth while to call the attention of the Geological Survey when they next come over this part of the country. The extraordinary depth of the sand in the upper part of the valley, thinning out, as it does, down the valley, points in the same direction. I conceive it to coincide in general position with the S.W. side of the valley of the Hillmorton brook, and to extend from the neighbourhood of the Hillmorton wharf, between the upper and lower villages along a well defined line, to below or east of the L. and N. W. cutting on the Clifton road, and possibly further. Along this line are first the great sand pits and sand hills, the sand being of unknown but great depth, and then the deep glacial drift of reformed lias on the Clifton road on both sides of the valley.

'Probably it is to this fault that the quicksand is due. It has depressed a part of the surface of clay below all its edges, and so made a basin or rather trough. This was once a lake, and gradually filled by the sand and fine mud washed into it, and converted into a flat marsh, liable to floods. On this peat grew, and it in turn is now overlaid by vegetable soil.

'But further, the Hillmorton fault may perhaps serve to explain the existence of the "oolitic drift," as I have formerly called it, of Brownsover. This I described to the Society in a paper printed on p. 20 of the report for 1871. Very briefly to recapitulate that paper, there exists on the Brownsover plateau a considerable deposit of oolite, shewing at the surface in blocks that work up through the surface soil, and exposed in one or two pits. It is unstratified, or nearly so, as far as I have had opportunity to examine it, but remarkably pure, and of unknown thickness. Further on the slopes towards Newton there is a gravel pit of which a large proportion is oolitic in its origin. This pit is described and drawn by L. Maxwell in the report for 1873. I will now add a few further particulars

about this "oolitic drift." It is found on the top of one of the spurs of the Brownsover plateau that runs down into the valley of the Swift, the spur immediately south of that on which in the Ordnance Geological map the letter *g* is printed. It is traceable in the fields at the top of this plateau, and on both slopes of it; near an old barn in the fields close to the bye-road leading to St. Thomas's Cross it may be seen turned up, and used for building the house, &c.; here it has a Stonesfield slate character. It was worked in considerable quantities in a field nearly due west of Miss Davy's house at Newton, and distant from it about a quarter of a mile on a slope facing N.N.E., in which a large excavation, now ploughed over, is still to be seen. Here I am informed was once a limekiln. A nearly similar oolitic drift is to be seen between the Clifton road and the railway, just beyond the canal, from which striated stones have been at various times brought to the Museum, and on which I annex a note from a former member, E. B. Lowe, and exhibit his specimens. This would seem from its mixed nature to be the limit of the deposit. It is fragmentary and mixed. Moreover, as far as Lilbourne and Stanford pieces of oolite are occasionally seen, as Mr. Boughton Leigh informs me. Also the drift by Newton, and from there to Watling street, contains much oolite. Members of the Geological section will be doing excellent work if they will trace the extent of this particular drift.

'Now in the paper before alluded to, I said that this oolitic deposit might be accounted for by the theory of a fault, but then there seemed to me to be no other ground for the hypothesis, and I rejected it in favour of the view that the oolitic deposit was a remarkably pure drift; such as does exist in a few places elsewhere. And this view was approved of by some geologists to whom I shewed the deposit. But evidence as to its greater extent had been then accumulating, and in July I had the advantage of shewing this deposit to Dr. Oldham, and he pronounced very decidedly that it was not drift, in any ordinary sense of that term; it was too pure and too extensive; a mass stated to be considerably more than 10 feet thick, and traceable almost continuously over more than a mile and a quarter in length, could scarcely be supposed to be 'drifted.' But then it flashed across my mind that the Hillmorton fault would, if continued a mile or so further, actually produce this very phenomenon of an oolitic outlier on that high land at Brownsover and Clifton, and thus the theory of the Hillmorton fault has received unexpected confirmation.

'One verification of this theory has not yet been made, and that is to find *upper* lias and marlstone fossils in the clay on N.E. of this fault. For these we ought to institute a search. Unfortunately I do not know of any pits in that region.

'The fault will according to our present knowledge run through Hillmorton towards the N.W., following the lines of the Hillmorton brook, the Avon valley and the Swift valley. The amount of the throw is unknown, but it must be not less than 120 feet at Hillmorton, and would seem to be not less than 500 feet at Brownsover,

and it may be as much as 700. It must be observed that this fault is nearly in a line with the Nuneaton fault that bounds the Warwickshire coal field, and agrees with it in having its downthrow on the N.E. side. And its continuation towards the S.E. passes through the Kilsby Tunnel, and may therefore be connected with that mass of sand among the lias, which contained the almost inexhaustible supply of water that so embarrassed Stephenson in the construction of the tunnel.'

H. T. S. Houghton (A) read a Paper on the '*Ordnance Survey.*' He described the history of the Survey: the methods of taking observations and of reproducing the maps: the application of photography for reducing the scale: improvement in the instruments, &c.

Mr. Wilson made a few remarks, shewing the minute accuracy of the Survey.

MEETING HELD JUNE 27. (32 present).

Exhibitions: Gold nuggets and quartz, and gold mixed with sand, &c.; by L. Knowles (M).

Papers: H. W. Trott (M), read a Paper on the '*Will-o'-the-Wisp,*' from which we extract the following.

'The Will-o'-the-Wisp, or Ignis Fatuus, is, as most of us know, a light that appears at night over marshes, in burying grounds, fields of battle, and low meadows. Its appearance is that of a small flickering light, about the size of the flame of a candle, straggling in an irregular manner generally at the height of one or two feet from the ground, and sometimes standing for a few moments over a particular spot. When approached or pursued, the light is agitated by the motion of the air, and seems to elude investigation. It has been known to change colour from red to yellow, and it generally grew fainter as any person approached, vanishing entirely when the observer came very near it, and appearing again at some distance.

'The Ignis Fatuus of the churchyard and the battle-field is probably nothing more than the *phosphuretted hydrogen* emitted by animal matter in a state of putrefaction, which spontaneously ignites upon contact with the oxygen of the air; while the flickering meteor of the marsh has been thought to be *carburetted hydrogen*, formed by the decomposition of vegetable matter in stagnant water, ignited by a discharge of the electric fluid, or by contact with some substance in state of combustion. But this is scarcely probable. Sir Isaac Newton defined the Ignis Fatuus to be "vapour shining without heat."

'The following extract will show that it possesses heat as well

as light. The account is given by a gentleman who examined the light carefully in a marshy valley. "The water of the marsh is ferruginous and covered with an iridescent crust. During the day bubbles were seen rising from it, and in the night blue flames were observed shooting over its surface; on going to the place at night, I observed bluish-purple flames, but when I reached the spot they retired, and I pursued them in vain. On another day, at twilight, I went again to the place, where I awaited the approach of night: the flames became gradually visible, but redder than before, thus showing that they burnt also during the day: I approached nearer, and they retired. Convinced that they would return again to the place of their origin, when the agitation of the air ceased, I remained stationary and motionless, and observed them again gradually approach. As I could easily reach them, it occurred to me to attempt to light paper by means of them; but for some time I did not succeed in this experiment, which I found was owing to my breathing. I therefore held my face away from the flame, and also held a piece of cloth as a screen; on doing which I was able to singe paper, which became brown-coloured and covered with a viscous moisture. I next used a narrow slip of paper, and enjoyed the pleasure of seeing it take fire." Thus proving that the gas was an inflammable one.'

H. Vicars (M), read the following Paper on '*Owls.*'

'Some time ago I came across a white owl's nest in a large and partly hollow tree. I climbed up to the hole, and though I could neither see nor get at the nest I knew it was there, for I had seen the old birds go to the tree, and could hear the unmelodious hissing of the younger members of the family inside. To find out more exactly where they were, I kept them hissing by hissing myself, (they would continue this amusement by the hour) until I had settled where the nest was. I consulted the gamekeeper as to the best way of getting them out. He suggested a ferret, and as no other means presented themselves I agreed. So the ferret was brought, and having fastened a collar attached to a thick string round his neck, he was sent down the hole. Soon, sounds indicative of a contest were heard issuing from the depths of the tree, whereupon the gamekeeper remarking "he's got him," proceeded to lug the string. Soon the ferret appeared pulling along with him a young owl, who, judging by his behaviour, did not seem particularly to appreciate the mode of conveyance. We repeated this operation 3 times and got 3 owls. When I got them back to the house, the question was, what to do with them and where to put them; several places were suggested, but at last a large work-basket carried the day. In this they lived for some days, (or rather, were supposed to, for they never could be induced to stay in it for more than 5 minutes at a time), and then they had to be moved; for the scene already related took place in Essex, and as the Winter Term was soon going to begin, I had to return to Rugby; so they were packed up in a small basket and brought down here. Again the question was, where to put them. I had at that time about a dozen doves

which I kept in a large place that had once been a hen-house; I suggested putting them in with the doves, but everybody said that the owls would eat them: I didn't believe it, and determined at any rate to try the experiment. The doves did not seem enchanted by their first sight of the owls; they stared in an astonished sort of way when they saw their new companions scuttling along like awkward quadrupeds into the inner part of the house. The owls always liked the dark, and so invariably bolted back into the inner room when they had been brought out into the outer wire part. This journey was generally performed in the most peculiar way. They would open their wings wide, stoop their heads till within about 3 inches from the ground, and then by a series of runs and hops in this extraordinary position, would make the best of their way back again. This was always the method of locomotion till they found out that flying, besides being easier and more convenient, was also quicker. The doves however did not seem to appreciate their appearance any more as birds than they had done when they looked like quadrupeds; in fact, they seemed to like them a great deal less; for the owls, like all owls, flew so quietly that the doves could never hear them coming; and in consequence they would be suddenly frightened into fits, by seeing a great white thing shoot past over their heads into the inner house. As the doves did not like this, they invented the very simple plan of never taking their eyes off the owls while they were in the open; of course now they could not be taken by surprise, and that was what they objected to. The owls on their side never took the smallest notice of the doves, either with the view of dining on them, or in any other way molesting them. Sometimes when I have gone down at night with a lantern to feed the owls, one of the doves would take it into his head to fly. In consequence of the light not being strong enough for its eyes, it would blunder about in the most helpless manner, hitting the ceiling like a blue-bottle, and at last as often as not, would perch upon the head of one of the owls. Even this did not disconcert those imperturbable birds; they would quietly wait till the dove came off, which it generally did after 2 or 3 minutes, and then would slowly turn its great head and calmly stare at the intruder. No dove was ever able to stand that gaze for more than a few moments, and it would again go off on another blundering expedition.

'It might be perhaps worth mentioning, how and what my owls ate. First, how. They always swallowed their food whole if possible; if not, they would tear it in pieces and devour it bit by bit. They have got most enormous throats and decidedly wide mouths. One of my owls once swallowed a largish rat's head whole; this may give *some* idea of their capabilities. Mice were always swallowed whole. They always swallowed their food head first (if it had a head); if it had not, that part which was most like a head. Mice, frogs, bats, rats, beetles, and moths, and of course raw meat, formed their principal food; they would eat worms and tadpoles occasionally. When they were going to eat, they would take the meat in their beaks first, then quickly seizing it with their claws, would fly

away with it. They never carried anything in their beaks for more than a moment; and even if they were obliged to start with it so, they would change it to their claws while flying.

'They had the strongest objection to having anything taken away from them that they had once set their hearts upon, and they would kick and flap about in the most insane manner if one attempted to do so. In fact it was almost useless to try, for they held on so tight and struggled so hard. All the time I had them I never knew them drink, though there was always plenty of water for them if they had wanted it. I can't positively say that they *did not* drink, but only that I never saw any signs of it. It is however a well-known peculiarity of birds of prey to be able to go without drink for extraordinary lengths of time.

'My owls were all excessively tame and on the whole very good-tempered. It took a good deal to make them angry, and even then never did anything more than hiss and snap their beaks like a pair of castanets. They never bit, and rarely tried to scratch. They knew me very well, and were not the least afraid of me. To a certain extent they tolerated all males, but if any individual of the other sex came to see them they would flutter and bang about as if they had seen a ghost, and even my presence could not restore their equanimity. Of course all ladies refused to believe that they ever were tame. Happily for the neighbourhood they never screeched nor made any noise whatever besides hissing, and with this amusement they used to while away the hours of the night. For the benefit of those that never heard a white owl's "hiss," I will describe it. It is exactly like the noise produced by an irate schoolmistress enjoining silence on an uproarious infant school. As may be imagined this sound is far from melodious, but, luckily, not at all penetrating.

'I have had at various times a great many pets of different sorts and kinds, and I must say that out of the whole number I never had any more thoroughly interesting and amusing than my owls. One night, after I had had them about a year, they walked out of an open window and were heard of no more. So ended my owls. I will conclude by asking a question. Is it a fact that white owls lay two eggs and hatch them; and then, when the young ones are a week or ten days old, lay another and leave that for the young ones to hatch? then in about a fortnight lay another, and so on? This theory was put forward by the afore-mentioned game keeper on his own eyes' authority. He said that he had seen it; that, in fact, there was no doubt about it. This theory, however strange it may seem, accounted for one peculiar thing about my owls, viz., that they were all of *distinctly different* ages, though they come out of the same nest. One was nearly fully fledged, and had only very little down sticking on his head, back and breast feathers. The next was not nearly so well fledged, and was much more downy. The third was nothing but down and a few pen feathers half expanded, and not half the size of the largest. Can anyone either confirm or contradict this theory, or give any definite reasons for this seemingly strange and unaccountable difference in size?

R. D. Oldham (A) read a Paper on the '*Subwealden Explorations*,' illustrated by numerous diagrams. The following is the substance of the Paper.

'The Wealds, of which I am going to speak, lie in the S.E. of England, comprising Sussex, Kent, and Surrey. They are surrounded on the N., S., and W. by the chalk escarpments, and on the E. by the sea. Just inside the chalk run the upper greensand and gault, which form low-lying grounds; then inside these is the escarpment of the lower greensand, rising in some places as high as the chalk; then comes the Weald clay, which forms a low tract of country, and inside that again rise the Hastings beds. The Weald is altogether a unique tract of land, and as it has been for some time felt that no one can get a right impression of its valleys and escarpments from a map, a geological model of it has been made, a copy of which is before you.

'The fact of there being escarpments on both sides facing towards the centre, shews that it must be formed on an anticlinal axis which has been worn away. Thus the chalk used to extend right across at a height of 800 ft. or more above the present level, yet not the slightest vestige remains of this immense mass of rock. For a very long time geologists thought that the Weald was formerly a bay, and that the chalk hills were old sea cliffs, but on examining it closer we must accept Professor Ramsay's theory.

'For if we look at a section of the Weald and restore the sea-line so that the chalk hills would be sea cliffs, we notice first the chalk hills on each side, then inside that at a short distance would come a strip of dry land, or rather a row of islands forming the escarpment of the lower greensand, then a space of sea, and in the middle a cluster of islands which are the Hastings beds. Now in this we notice two things; 1st, that this is not an open expanse of water where waves could act so as to make cliffs; and 2nd, that the surface is not like that left by marine denudation, which would be a level plain, like the country round Rugby. So Professor Ramsay says, (and he is most probably right, though some geologists differ from him), that *the whole or nearly the whole denudation of the Weald has been subaërial.* He does not say however that the rain, &c. has removed the chalk right across the Weald, but that the sea denuded the top of the anticlinal, and that the plain so made has been worn away by subaërial influences. The ground for saying this is that flints are only found for a short way from the base of the chalk escarpment. Now one peculiar feature in the Weald, which cannot be explained by the theory of marine origin for the chalk escarpment, and which has been explained by Professor Ramsay, is the behaviour of the rivers. One would expect that in the Weald there would be two large rivers running E. and W. down the low lying Weald clay and so into the sea, but such is not the case except with a few insignificant streams.

'Going along the South Downs, beginning at the E., we have first the Cuckmere, then the Ouse, then the Amur, and then the Arun.

All these rise in the interior and come right up to the chalk hills, where they are not turned aside by them, but simply pass through valleys ready cut for them, and the same is the case on the North Downs. Now it would be strange if the sea, when making chalk cliffs, should also have made valleys through them, and it would be still more strange if when the Weald were elevated above the sea, the rivers should be so uncommonly lucky as to find a road ready made for them through the chalk. But all this difficulty is done away with if we suppose, with Professor Ramsay, that the rivers used originally to run right over the tops of the hills and have gradually worn their way down to their present level. Again, when the sea has been denuding a tract of country it generally leaves a mark of its presence in the shape of marine drifts, while in the Weald there are *no recent surface deposits, except in places, of flints which have been dissolved from the chalk, and fresh water gravels and alluviums*. So it would appear to be established that the denudation of the Weald has been subaërial.

'If we now cross the Channel we find a district corresponding to the Weald, called the Bas Bolonnais. A detailed comparison of the beds in the Weald and the Bas Bolonnais led geologists to suspect that the oolites underlay the Wealden beds in Sussex, and that the lowest Wealden beds, then called the Ashburnham Limestones, were Purbeck beds. And so it was determined to make a boring, partly to see if this were so or not, and partly to see what underlies the Weald. Now one great and very popular mistake is that this boring, which is being carried on by a committee, supported by general contributions, is a boring for coal. This probably arose from its object being to see if coal-measures underlie the Weald, but only in a very subordinate degree. But perhaps some of you will want to know what made people think that there would be coal underneath the Weald. This is a subject which has been forcing itself upon the attention of geologists for many years past, and it is now almost certain that a ridge of Palæozoic rocks must go under the Weald. The reasons for this conclusion are as follows.

'Probably nearly every one, who knows anything of geology, knows that after the deposition of the coal-measures, but before the Permian, there were great forces of disturbance exerted, producing a marked anticlinal axis, which extends across the south of Ireland and appears in England in the Mendip hills, where this axis goes underground. But both in the Mendips and in the Somerset coalfields there is no sign of thinning out of the strata as if they were approaching an old shore, and so geologists began long ago to think that the coal-measures must spread a great distance to the east. If now we look towards the Continental coalfields, we see that the area covered by them is very long in proportion to its width; thus the coalfield of Liege is 3 to 8 miles wide and 45 miles long; so the exposed coalfield from Namur to Charleroi is 33 miles, and its underground extension, with a few exposures, 32 miles, thus making a length of 65 miles, while it is only 7 miles broad at the broadest part. It was for a long time supposed that this coalfield

did not extend beyond Valenciennes, but about a century ago the line was recovered at Auzin, and has been followed to Enquin, within 30 miles of Calais, which is 54 miles from Valenciennes. West of this point older rocks are found *immediately below the chalk.*

'This similarity in position and in direction of disturbance would lead to the suspicion that the Belgian coalfields were once part of the Somersetshire coalfield; and this can be confirmed by other facts. If the formation had been anything but the coal-measures, we might expect to be able to identify some strata which would be sufficient to identify the whole formation. But when we find that between two coalfields so close together as the South Wales and Somerset, and even between adjacent pits, some seams of coal die out and others set in, so that a coal-seam in the South Wales coalfield is not recognizable in the Somerset—even in adjacent pits the seams are so different that they have different names—and when we find the same to be the case on the Continent—thus a seam at one end of the Liege coalfield cannot be recognized at the other end—we cannot expect to identify any seam when there is such a wide interval as there is between the Somerset coalfield and the Liege and Charleroi basin. But we have other points of resemblance, one of which is the similarity of thickness, as in the following table:

S. WALES.	SOMERSET.	HAINAUT.	LIEGE.	WESTPHALIA.
11,000 ft.	8,400 ft.	9,400 ft.	7,600 ft.	7,218 ft.

all of which dimensions are greater than those of any other English coalfield, except the Lancashire, which is 7,000 feet, while the others are only about 2,000 feet thick. Then again, no seams of great thickness are found, as in the other coalfields, 6 feet being an extreme case; 2 to 3 feet is considered good workable coal, and even seams of 1 to 1½ feet are worked. The approximate number and total thickness are as follows:

	S.WALES.	SOMERSET.	HAINAUT.	LIEGE.	WESTPHALIA.
No. of seam.	75	55	110	85	117
Total thickness of workable coal.	120 ft.	98 ft.	230 ft.	212 ft.?	294 ft.

'The chief reason for there being a greater thickness of coal in the Continental fields is the absence of the Pennant grit, which has but little coal in it. These are the chief points of resemblance, but there are many other minor ones which I will not mention now. So that there seems little doubt that the Liege and Somerset coalfields were once more or less continuous. Now this axis has been traced as far as Calais, and has also been found at Harwich, where they reached the Palæozoic rocks at 1030 feet below the surface, *lying immediately under the cretaceous rocks without the intervention of*

any of the oolitic strata. And again, at Kentish-town, on the N. side of London, at 1,114 feet below the surface. Thus there is no doubt that an axis of Palæozoic rock runs under the South of England.

'Now when the British Association determined to hold a meeting in 1872 at Brighton, Mr. Willett, one of the local secretaries, looked out for something which would make the meeting remarkable: so he thought that if they could solve what was then the chief geological problem left unsolved, they would make the visit of the British Association to Brighton a memorable event. When once this was determined upon, there were three things to settle.

'I. Whether they could get the money? Of this they had little doubt.

'II. What plan they should adopt in boring?

'III. What site they should choose?

'As to the site. Of course, in an experiment like this, it was necessary to commence from the lowest beds, so as to save unnecessary expense.

'Now the lowest Wealden beds are those that were called the Ashburnham, which may be divided into the upper mottled clays and contiguous beds, and the limestones at 200 feet below these clays. These had been suspected for some time to be Purbeck limestones, and they have been proved to be so by the boring. Now there are only four areas where these beds crop out: 1, the Brighting and Pounceford area; 2, the Netherfield area; 3, the Archer's Wood area; 4, the Fairlight and Ore area.

'The Netherfield area was finally chosen. Here there was a crest of an anticlinal, where they have set up the machinery. On the 27th of May, 1872, the 4th pole was in place and the machine fitted up ready for the excursion of the geological section to see it. The boring machine is constructed as follows.

'A large frame is made of 4 beams with cross-bars, at some height from the ground. This is to guide the rods. Then there is a large toothed wheel which works a square rod 20 feet long, which passes through the scaffolding over the hole, into the bottom of which is screwed the rod with the auger at the end. This is worked up and down while it turns round, and all the time a man keeps his hand on it, and is able by practice to feel if the auger is biting or not. This is an important point, for as iron rods twist it takes on an average $\frac{5}{4}$ of a turn for every 20 feet before the auger bites, that is, 6 whole turns for every 100 feet: so if the man does not feel the auger biting at 100 feet, after 6 or at most 7 or 8 turns, he pulls up the rods and looks for the weak joint. Theoretically, the strain would be spread equally over the iron rods, but as they are not homogeneous, they would give way at the weakest point. The machinery which was set up for this excursion did not do of course for actual work, but had to be altered and strengthened.

'The site of the boring is on a steep hill, which is perfectly honey-combed with former limestone workings, which partake rather of the nature of mines than pits, being tunnelled in various directions. These workings get filled with rain, which forces large

masses of limestone into the valley below, and has thus made 8 or 10 feet of deposit. The workings were set up on a horizontal shelf of such deposit, and the heavy rains which came on shortly after caused a subsidence, so the rope fastenings had to be renewed by iron ties, and though through great efforts of those who were carrying on the boring, the bore was kept perpendicular, yet it took up time and money. Another thing was that in the original calculations by Mr. Bosworth, the engineer, he calculated on a diameter of 6½ to 7 inches: as not only is the risk of the sides falling in very much lessened by a decrease in the diameter of the hole (as the square of diameter), but if they do fall in, the *debris* is easier to get out. This plan would do away with the old telescopic or diminishing system of boring. But as it was thought of such importance that the boring should be carried down to 1,500 feet, the central committee determined that a diameter of not less than 9 inches should be adopted. Now, not only did this alteration involve the removal of a larger amount of rock, but the increased resistance to the auger caused so great a strain on the rods as to retard the rate of progress by considerably more than 50 per cent.

'For the first 70 feet they went through limestone and shale, which were not new to science, and then the real work began.

'Next came a bed 10½ feet thick of hard shales.

'At this point Mr. Willett, at a meeting of the central committee, proposed that the diameter should be reduced to 6½ inches, but the importance of reaching 2,000 feet, unless Palæozoic strata were reached, outweighed the question of expense. The very day of the meeting the drilling tool broke off, leaving a flat chisel, 9 inches wide tapering to 2 inches in the hole, and a fortnight was lost in trying to recover it; at the end of which Mr. Bosworth got it up from a depth of 96 feet; but the sides of the hole were so knocked about in doing this that they had to discontinue drilling, and it was absolutely necessary to have recourse to the safer but slower process of boring. With this instrument they sometimes progressed at little more than 1 inch per hour, on account of the composition of the rock, which was carbonate of lime and sulphuret of iron, mixed with clay shale. This polished the hardest steel tool so that it slid over the rock instead of biting and cutting: so recourse was had to the drill, with which they made good progress—14 feet in one week. The strata now began to change, and the marl became gypseous, till on January 28th, 1873, they came upon a mass of pure white crystalline sulphate of lime (statuary alabaster). This was at 131 feet below the surface, and was 4 feet thick; then came 10 feet of gypseous marl and 3 more feet of alabaster. Afterwards, 15 feet of more or less pure gypsum, varied by seams of selenite and satin spar, making 32 feet of more or less pure gypsum. This was the most important result economically that can well be expected for some time yet, as no such deposit of gypsum, which is the largest in Europe, was ever dreamed of in Sussex, and sulphate of lime is very valuable agriculturally. The fact had scarcely become known before other people set about boring for gypsum

in the neighbourhood. As to the probable origin of this deposit, I can hardly do better than read an extract from the Paper of Professor A. H. Church, on the Chemical Causes of the Varied Colours of the Forest Marble. "Whenever bands of limestone are either fissured or exposed near the surface, it will be observed that the blocks are not only detached from one another, but exhibit the same difference in colour remarked by the author in the detached blocks of the Forest marble of the great oolite of Gloucester, namely, the exterior is a light buff, and the central portion a dark bluish grey. It is probable that upon minute and apparently insignificant peculiarities of composition, very important geological changes may depend." Now the central portion, he goes on to say, contains a much larger total proportion of sulphur, the greater part of which occurs as insoluble as sulphide of iron or iron pyrites. Where water, or water containing oxygen in solution gets at this, the iron is oxydized and the water runs off, with sulphate of lime in solution. This is a salt which requires 120 parts of water for its solution, and if such a solution were evaporated in a basin it would make a gypsum bed.

'To return to the boring. About here a new chisel was tried, which broke off, and the extractor was dropped in getting it out. The extractor was raised, but two days were lost in getting up the chisel. At 186 ft. they passed through the last gypsum, and struck a layer of sandstone mixed with chert. The water in the bore sunk 40 ft. immediately, and the well which had supplied the engine ran dry. At 213 ft. it was determined to take Mr. Bosworth's tender to carry the bore down to 413 ft. for £190.

'The sandstone they were then in was silicious enough to scratch glass and cut the steel chisel as a file would soft iron. On July 5th the beam which had been sprung and spliced sprung again, and threatened to break at every blow. On July 17th the mud auger met so much resistance in breaking off the core, that the rods were torn asunder. 120 ft. of rod were lifted, and the extractor lowered, and the rest brought up in half-an-hour. On July 18th the *debris* was nearly black and sulphurous, and from its general character Mr. Willett thought it probable that it was Kimmeridge clay; some was sent to Professor Phillips, who found a *Lingula ovalis* like those found elsewhere in the Kimmeridge clay. On July 29th the new beam was fixed. On August 2nd the T chisel stuck in the hole, and was got up on the 4th by a series of upward strokes of the cam. The Kimmeridge clay probably begun at 290 ft., which is 86 ft. above the point where a detailed examination of the cores began. Of all the rocks pierced the first 180 probably represent the Purbeck, and the next 110 the Portland beds.

'At a meeting of the committee it was determined to adopt the tender of the Diamond Boring Company. As this method of boring is likely to supersede all others except in running sand, I will give a short description. The solid rods of an ordinary boring machine are replaced by tubes or tububar rods, at the end of which is screwed the core tube 15 ft. long. The whole is revolved at the rate of 150 revolutions a minute in soft rock, and 300 in hard, and

into the end of the core tube is screwed a ring of soft iron, in which the diamonds are set.

'These diamonds are not the ordinary brilliants, but a sort found in Brazil, worth £2 or £3 each, and called carbonadoes, and the whole crown is worth £33. The advantages of these are two; (1) they are not quite so dear; (2) they have no cleavage planes, and so do not split. While these are revolving, water is pumped down the central cylinder of the tube, and passing out, though all round the diamonds it re-ascends to the surface through the boring, and thus keeps the diamonds clear. Several contrivances have been tried to catch the cores, but none have half succeeded: the diamond piece however projects into the tube, and so forms a ledge on which the core is almost certain to rest. The other day I was asked, what do they do when they come to a stone? so I replied, that they simply went through it. Now it is rather hard to believe at first, but it is a fact, that the harder the rock the faster it bores, its chief enemies being soft clay and running sand, which clog the diamonds. The rate in hard limestone or granite is from 2—3 in. per minute, 4 in. in sandstone, and 1 in. in quartz. An experiment was once tried on emery, which is harder than any rock ever met with in boring, and it was pierced at the rate of 2 in. in 1 min.

'Before beginning to bore, the Diamond Company lined the bore with 5 in. steel tubes: 280 ft. of the tube had been lowered when the upper clip gave way and the tube fell 20 feet. The bottom of the tube, although made of steel, was crumpled up like paper, while the upper half broke off; the upper part was soon extracted, but the lower part was firmly wedged in: so they set the diamonds to work, and at the end of 5 hrs. a solid core 7 ft. long was taken out. When they began to bore they completed in the week ending

	Depth of bores.	Total depth.	Core obtained.
	ft. in.	ft. in.	ft. in.
Feb. 7	14 6	320 0	3 6
,, 14	26 6	353 0	16 6
,, 21	36 10	389 10	14 4
,, 28	31 1	421 11	27 1
March 7	60 2	482 1	52 4
,, 14	57 3	539 4	30 0
,, 21	81 4	620 8	75 0
,, 28	50 4	671 0	20 0

'After this digression we will return to the rocks discovered. The Kimmeridge clay is very uniform throughout, and cannot be divided into zones, as it would not be fair to argue as to the absence of any particular fossils, from their not being found in a section 2 in. across.

'In the upper part of the clay *Discina latissima*, *Lingula ovalis*, *Modiola*, *Pecten*, *Ostrea*, and a doubtful *Lima* were found; some specimens from about 330 ft. shew no tendency to break up; from 380 ft. for 100 ft. or more the cores are difficult to preserve, the clay is very soft breaking into laminae, and where there are fossils.

At 480 ft. there are many veins of carbonate of lime crossing the cores at a high angle, but the strata are horizontal. At 500 ft. the cores are hard and break with a slightly conchoidal fracture. At 549 ft. more veins of carbonate of lime, some of which are just visible to the naked eye. At 640—650 ft. the cores are again hard and split with a conchoidal fracture. At 600—602 ft. is a tough, rather sandy, calcareous stratum, which when slightly warmed or struck gives out a strong smell of petroleum. At 604 ft., 6 in. of hard clay with petroleum. At 617, 622, and 651 ft. below the surface, there are also strong indications of petroleum. There are slight traces of petroleum all through the clay, from about 100 ft. from its top or 450 from the surface, but they are particularly abundant at the above-mentioned depths.

'Fossils are scarce, or absent where petroleum is abundant. As I said before, it is impossible to divide the Kimmeridge clay into zones in the boring, as we cannot argue on the absence of any fossil from its absence in a vertical section only 2 in. in diameter. The following fossils however are abundant or rare. *Trigonia* and *Alaria* are rare throughout, *Ammonites Biplex* tolerably abundant, *Cardium* also occurs all through but chiefly at the top. *Modiola pectinata* and *Lingula ovalis* are common all through but small at the top, and it is only at the bottom that full-sized specimens are found.

'The complete list of fossils from the Kimmeridge clay is as follows.

Discina (Patella) latissima. Sow.
Discina Humphriesiana (?). Sow.
Lingula ovalis. Sow.
Arca (including a form which is probably new).
Astarte aliena. Phil.
Astarte antissiodorensis. Cotteau.
Astarte Hartwellensis. Sow.
Astarte ovata. W. Smith.
Cardium Striatulum. Sow.
Cardium. (A smaller form).
Exogyra nana. Sow.
Gryphæa virgula. Dep.
Leda.
Lima.
Lucina.
Modiola pectinata. Sow.
Myocites.
Ostrea deltoidea (2). Sow.
Ostrea. *2 spec.*
Pecten arcuatus. Sow.
Pecten. (2 var. of P. leus).
Pecten. (A form with coarse ribs).
Pholas (? P. compressa). Sow.
Thracia depressa. Sow.
Trigonia.
Alaria.
Pleurotomaria.
Ammonites Biplex. Sow.
Belemnites hastatus. Blaim.
Belemnites. *2 spec.*
Hybodus. (tooth, fragments of fish-bones).'

MEETING HELD OCT. 3. (36 present).

The President announced that the Prize for Entomological Collection made during the holidays had been awarded to M. J. Michael (A).

Exhibitions: a number of curves beautifully etched on glass, by a Compound Pendulum, (see report of Meeting, Feb. 21): by W. Larden (O.R.)

(The glass plates are covered with a thin coating of paraffin, on which the figures are scratched with a needle: the glass is then etched with hydrofluoric acid).

Photograph from etching done in a similar manner; by H. F. Newall (A). Collection of Lepidoptera made in the Harz Mountains; by C. H. Wilson, Esq. Fossil echinus in flint, from Berkshire; by H. N. Hutchinson (M). Geological specimens from Giant's Causeway; by L. Knowles (M). Large Ammonite from the Lias; fine specimen of an Ichthyosaurus Coprolite; beautiful moss-agate; by Mr. Wilson.

Large Slab with curious markings; by Mr. Wilson. Dr. Oldham explained the great value of the specimen, giving the various conjectures of geologists as to the origin of the markings. The Slab was presented to the school collection by Rev. T. N. Hutchinson.

Two finished Water Colour Drawings of the Labyrinthodon (see Plate 1); by Dr. Oldham.

Specimens of Minerals from Matlock; by G. M. Seabroke.

Papers: Account of '*Entomological Expedition*'; by H. F. Wilson (A).

'On Saturday, July 4th, the Entomological section left Mr. Sidgwick's house at half-past twelve, in two carriages, one of them most kindly lent by Mr. Gillson, for a field-day in Princethorpe woods. The day was very favourable on the whole for entomologizing, and had it not been that the wood had devoted itself to the production of Tortrix Viridana (a not uncommon insect), to the partial exclusion of other and rarer species, the captures might have been considerable. As it was, Mr. Sidgwick and H. Vicars managed to catch several Tortrices, some of which were new to the district; and M. J. Michael took a fine dark variety of Camptogramma bilineata. A few Paphia were seen, and one caught; and C. Bayley caught three or four Aegeria (wood Argus). A few caterpillars of Vinula, and the imagos of Leucania Impura, Noctua Plecta, Cidaria Fulvata, etc. were among the captures. Cabera exanthemaria were also very common. One of the party made himself a name by capturing an immense horsefly in mistake for one of the clear-wings, but little errors of this sort must unavoidably happen. Lunch was discussed soon after arrival at the wood, and it need not be said that every one was exceedingly grateful to Mr. Gillson for the excellent fare which he had provided. On arrival at home, about

8.30, the entomologists were entertained at Mr. Sidgwick's, and so the day, which had been very enjoyable in every way, came to a close. The thanks of the society are especially due to Mr. Gillson for the interest he shewed in the expedition, and his kind help in rendering it so pleasant and effective.'

Account of '*Geological Expedition to the Wyken Colliery, near Coventry*'; by R. D. Oldham (M).

'On Saturday, July 5th, Mr. Wilson took several members of his geology set and others, 13 in all, to see the colliery at Wyken. We started at 12.35, and arrived at Coventry in due time, where we found a van waiting to take us to the colliery, and driving between three and four miles, we arrived at the pits. We went straight to the ironstone shaft, where we found Mr. Whittem, manager of the works, waiting for us. We saw there the trucks of ironstone and rubbish coming up every minute, and among the rubbish were found several *Stigmaria* and also specimens of *Lepidodendron* and *Lepidostrobus*.

'The ironstone is worked in three beds, the upper and lower consisting of nodules, or balls as they are called, varying from the size of a nut to large balls a yard or more in diameter; the central band is a white stone, about 6 to 8 inches thick, but it is found that wherever they get a larger ball than usual, there the other two layers are found to thin out. Passing into the engine house we saw the engine at work, and noticed the tell-tale by which the engine driver can tell whereabouts the cage is in the shaft, ascending or descending. Mr. Whittem then briefly explained to us how the coal seams lay. The surface consists of new red sandstone, in sinking through which they encountered considerable difficulty on account of the water, which had to be tubbed out. Under this the coal seams, with a few local exceptions, strike nearly N. and S., and have a dip of 1 in 3 to the W.

'The coal is worked on the modified long-wall system, by driving roads: in the first instance to the extremity of the estate, and then working back to the shaft—that is, the shaft is sunk through the coal to get a level space for the engines, stables, etc; then a passage is driven to the coal, after which they tunnel down along the coal until they reach the extremity of their property, or the intended limit of the works, and then work back, throwing the rubbish behind them.

'After this we went to the coal pits, where, after preparation by putting on old coats if we could get them, or jerseys if we could not, we went down the pit, and as the cage would not hold the entire party, we had to go in two sets. As soon as we reached the bottom we were led off into one of the passages, out of which we emerged into a large tunnel or main road, which they were driving to the face of the coal, that they might open another part of their estate, as one-half is nearly worked out. There we saw the coal seams, which are five. At the bottom is the slate coal, above that 20 to 30 feet of shales, then comes the bare coal, above that the

rider, then the ell, and lastly the roof coal. The bare, the rider, and the ell are worked as one seam, being only separated by thin partings of fireclay. The roof coal is not worked at all, as it is very hard, and so makes a capital roof which it is not expedient to remove. After examining the face of the coal, we came back to the stables where the pit ponies are kept, and, though they never see daylight except when there is a strike or they are ill, they look much better off than many ponies and horses above ground. We then went to see the engine underground, which pulls the trucks up the incline from the workings; we also saw the trucks ccme up the incline, but were too large a party to go with safety to the actual face of the workings. We then returned to day, and after a wash, which we very much needed, went to see Mr. Whittem's collection of fossils and rocks, among which were some fine specimens of Lepidodendron, and a rolled pebble of quartzite, found in one of the coal seams.

'And then the party visited the engine used for drawing the coal, which was much more powerful than the one at the ironstone pit. In returning to the road we passed the pumping engines. Mr. Whittem here shewed us a small hut which used to be above the level of the canal, but on account of the removal of the ironstone, the ground has sunk several feet below the level of the canal, which has necessarily been banked up.

'We now adjourned to the 'Boat Inn,' a cleanly and comfortable roadside inn near the colliery, where we found an excellent luncheon ready for us, after partaking of which we again mounted our van and returned to Coventry. Here we paid a hurried visit to St. Michael's church, and ascended the tower, from which a beautiful view of the rich agricultural country around us was obtained. Shortly after we returned to the station, and so back to Rugby, after a very pleasant day. The party was much indebted to Mr. Whittem, F.G.S., manager of the colliery, who in the most considerate way devoted himself to the party, and took great pains to explain every thing to us. To Mr. Wilson and the Secretary we were also much indebted for their foresight in having previously visited the place and made all arrangements.'

H. F. Wilson (A) then read the following Paper on the '*Great Spotted Woodpecker*.'

'My chief reason for choosing the great spotted woodpecker as the subject of my Paper, was that I believe that it belongs to the same species as the unlucky bird who was so rash as to build in the close last summer, and whose habits were an object of such curiosity to a member of the school, that he thought it best to take the eggs away from the hole, and examine them at his leisure. But whether this bird belongs to the same species or not, although we cannot expect the birds to be insane enough to come back again next year and repeat the process of building at a place where their beauty is not appreciated, still there is no reason that we should not know something of their habits, which are at the same time curious and

interesting. First of all, then, here is a specimen of the bird to speak for himself, with regard to his colour, size, and shape. He was shot in Norfolk, and died in the act of committing that crime for which every gardener considers a bird worthy of death:—he died with his mouth full of strawberries, and he deserved what he got.

'The great spotted woodpecker, Picus Major, is one of the 5 British woodpeckers, and is rarely seen north of the midland counties, though in some parts of Yorkshire it occurs locally. In Scotland a few specimens are on record, and in Ireland 11 have been met with from time to time. It is found over the whole of the European continent from Russia to Italy, Sweden to France, Denmark and Norway to Germany, besides elsewhere; it has been noticed in Asia, and has also been found in America. They are like the other woodpeckers, exceedingly active climbers, and run in an upward direction over the branches and trunks of trees, seeming at the same time to have a natural instinct for keeping a bough between themselves and a would-be spectator of their actions. Sometimes, though very seldom, they alight on the ground, but in this case their movements are clumsy and slow, whereas in the air they fly with extraordinary vigour and directness. About the end of March or beginning of April they begin to build, or rather to make a hole in which to deposit their eggs, for nests they have none; the glossy white eggs being laid at the bottom of the hole, on the dust and chips which have collected there. Sometimes they make a tunnel in the decaying wood to the depth of 2 feet, but usually do not go deeper than 6 or 7 inches, preferring a pine tree, if possible, but now and then selecting the oak. If there is no hole ready made, they scoop one out of the unsound part of the tree, and generally make another hole for the purpose of escape in case of danger. The young are hatched in about 15 or 16 days, and in a year's time are but very little smaller than the parent birds; though the colour of their feathers is not so bright. The females are the same as the males in colour, except that they have no red on the head. Their food consists of insects, caterpillars, seeds, and fruit, in the last-mentioned of which articles of consumption they are the cause of great destruction. In the woods where these birds are more or less common, a careful observer may watch their movements without difficulty by taking a few preliminary precautions. The rapid series of strokes on the bark will indicate the direction in which the bird is working, and when the intruder has drawn near to the tree on which he suspects the woodpecker to have settled, he should sit quietly down and wait. At first the bird will not be visible, for they have, as I have said before, a natural instinct for keeping the trunk or branch between themselves and their supposed enemy, and will not come out till they think he has gone. Presently, however, the woodpecker comes round the tree in a cautious, inquiring sort of way, looking here and there to assure himself that the coast is clear, and then sets to work in good earnest. Chips and bark fly about in all directions, and should the tree be old, whole heaps of bark will be found at the foot of it. It has several modes of tapping the trees, which may readily

be distinguished with a little practice. First, there is the preliminary tap and the quick strokes which it makes while seeking its food. Then there is a curious sound made by pushing its beak into a crack, and rattling it in such a manner against the wood, that the insects think their house is falling and come out to see what is going on; just as worms come to the surface when the ground is agitated by a spade or fork. Lastly, there is a kind of drumming sound made by striking the bill against a hollow tree, and which it uses together with a peculiar cry for calling its mate.

'Woodpeckers have been much persecuted at one time or another, under the idea that they are destructive to the trees. But in reality they are extremely beneficial, for they cut away the diseased wood and put a stop to the hosts of insects which have taken up their abode there; for if these were left alone, in a few years the tree must fall. They also seek their food on old posts and rails; and are especially fond of the black ants which climb up the trees infested with aphides, or blight. We should also be grateful to the woodpeckers for eating those creatures known as woodlice, which are most destructive to trees. But, unfortunately, they do not always confine themselves to this diet, and are very fond of fruit, always alas! choosing the ripest. They are so rare in England that they can do but little mischief in this way, but in some countries, such as America, they are known to do very great damage, stripping the trees of their fruit to such an extent that they are annually shot by hundreds.

'One of these birds, which had probably strayed from Kensington Gardens, was observed early one morning cautiously making its way up a house in Cavendish Square; a fact which illustrates the extraordinary climbing powers of these creatures, for the side of a house does not offer much facility even to an experienced acrobat. One more fact is gravely related by a German naturalist: "The jealousy of this bird is apt to lead it into danger, as it is sure to notice if anyone taps against a tree, and sometimes on these occasions approaches near enough to be caught with the hand." Whether this is to be believed or not, I leave you to judge, but I confess I should like to see this same German naturalist while he is catching the great spotted woodpecker.'

The following Paper on '*Migrations*,' by W. C. Marshall (O.R.) was read by the President.

'I came across a curious old pamphlet the other day, called "A Discourse on the Emigration of Birds," by a naturalist, dated 1780, after which some one has written G. Edwards. I send you a few extracts and remarks on the early theories on the subject, thinking that they may serve to stop a gap in the Natural History Society's debates, and be of some interest at the present moment, when the subject of migration of birds is being discussed in the papers.

'In his introduction Edwards says: "This subject, curious and advantageous as it is, has hitherto been too much neglected. Naturalists in general are silent on this head, or very superficially

consider it. Almost all other topics, whether frivolous or important, useful or not useful, have claimed their regard, and been so frequently discussed by such a multiplicity of writers that they are quite exhausted, and dwindle into tautology."

'I think we may fairly agree with him that his subject is "curious" without conceding that natural history is generally exhausted. The oldest remark on the subject that Edwards has found is that of Jeremiah viii. 7; "Yea the stork in the heaven knoweth her appointed times, and the turtle (woodpigeon), the crane, and the swallow, observe the time of their coming." This however, though recognizing their disappearance and reappearing, does not give any theory on the subject.

'Four theories have apparently been put forward.

'One very old one is, that they hide in holes in sand banks, in hollow trees, caverns, and such places, and remain dormant during the winter; this theory has received the support of Aristotle and Pliny and many authors down to the present time. Numerous instances more or less well grounded have been placed on record; among them a curious story by Mr. Acland was read before the Royal Society in 1763.

'Mr. Acland observed a number of boys let over the edge of cliffs on the Rhine, from 50 to 80 ft. high, by ropes, and was told by the watermen that they were catching hibernating swallows; this they achieved by shoving a long rammer, with a screw at the end, into the holes in the sandy cliffs. Mr. Acland procured some birds from the boys, and says, "I put one of them in my bosom, between the skin and shirt, and laid another on a board, the sun shining full and warm upon it; and one or two of my companions did the like. That in my bosom revived in about a quarter of an hour. Feeling it move, I took it out to look at it, and saw it stretch itself upon my hand, but perceiving it not sufficiently come to itself, I put it in again; in about another quarter, feeling it flutter pretty briskly, I took it out and admired it; but being now perfectly recovered, before I was aware it took to flight." This happened about the end of March, and Mr. Edwards suggests that these were probably only sand-martins which come in March, and that they were not benumbed by cold, but hurt by the cruel method of getting them out of the holes.

'Mr. Edwards dismisses this theory of hibernation as a "superstitious error," which seems a strong term, as he admits that there are many well-authenticated cases of swallows being found concealed in holes, &c. up to Christmas, and that they occasionally come out on a mild winter day. But he maintains that these are only stragglers that were hatched too late to join in the general emigration, and doubts if they ever survive the winter.

'The second theory is, that swallows pass the winter immersed under ice at the bottom of lakes, or beneath the water of the sea. This theory was first maintained by Olaus Magnus, Archbishop of Upsal, who seriously acquaints us that "swallows are frequently found in clustered masses at the bottom of the northern lakes,

mouth to mouth, wing to wing, foot to foot, and that they assemble together for this purpose, and creep down the reeds in autumn to their subaqueous recesses."

'Many others have believed in this "erroneous assertion, monstrous to thought," as Mr. Edwards calls it. Among them Klein, who says he heard from countrymen that the birds assembled in numbers on a reed, till it broke and sunk with them to the bottom; and before their immersion they had a dirge of a quarter of an hour's length. Others would unite in laying hold of a straw, and so plunge down in society. After detailing several such accounts, Mr. Edwards says: "In relating so many instances of unparalleled credulity, I confess I cannot suppress the irascible passion; that ever men of sense, men of genius, men of distinguished abilities, should suffer themselves to be so involved, so deeply involved in the dark mists of error and ignorance! They assign not the smallest reason to account for these birds being able to endure so long a submersion without being drowned or suffocated. Not the smallest reason is given how they preserve themselves, or remain without decaying in such a cold and turbulent element, which must be very unnatural to so weak and delicate a bird."

'We now come to the third theory, which was brought forward in a pamphlet about the year 1740.

'The author asserts that they fly to the moon or some other planet, where they take up their abode during the winter, and return from those aerial habitations again in the spring. The author of this rhapsody has taken infinite pains to confirm this strange and novel supposition; he thinks that they are about two months passing thither, and that "after they are arrived above the lower regions of the air, into the thin æther, they will have no occasion for food, as it will not be so apt to prey upon the spirits as our lower nitrous air." "Even in this terrene," saith this author, "bears will live upon their fat all the winter without any new supply of food; and perhaps these birds, being very succulent and sanguine, may have their provisions laid up in their very bodies for their voyage." He also expects that the birds are in a state of sleep from the counter attraction of the earth and moon a great part of the way, "to which sleep the swift acquired motion may contribute."

'"Moreover, if it can be proved that these birds do not fly to the moon, who can tell but that there may be some concrete bodies at much less distance than that opake planet, which in all probability may be the recess of these creatures, and may serve but for little else than their entertainment? If there be such aethereal islands they must be of such magnitude and at such distance that their reflective light may not reach our earth, and yet no further off but these birds may arrive unto them in due time."

'This notion of flying to the moon, Mr. Edwards thinks requires no confutation. "The moon," as Mr. Jonson, in a letter to Mr. Ray, very justly observes, "is too far a journey for these birds."

'But, notwithstanding the extravagance of this notion, Mr. Edwards thinks it worth while to observe, that "these feathered

nations would die inevitably if removed beyond the mass of air that surrounds the earth, for want of that uniform pressure which is the spring of internal motion in the animal machine."

'Mr. Edwards then goes on to discuss the theory of emigration to warmer climes, which "coincides exactly with his sentiments." He gives some careful observations of the departure and arrivals of different sorts of swallows, which he makes out extremely uniform in their times, and he goes on to discuss the migrations of other birds; but the object of this letter was to give some of the quaint ideas and quaint language of the old naturalists. And I do not know enough about the subject to tell how far his remarks are correct. The large number of species which are to a certain extent migratory, and the absence of positive evidence as to where they go, are the most striking features of the enquiry to me.'

MEETING HELD OCT. 24. (45 present).

Donation: box of valuable moths; by Mr. A. H. Wratislaw (O.R.) (see Report of Entomological Section).

Exhibitions: collection of rare minerals, meteorites, &c.; by Rev. T. N. Hutchinson. Curves drawn by Compound Pendulum, (see Meeting, Feb. 21); by H. F. Newall (A). Connemara marble, and Celtic axe-heads, from Giant's Causeway; by L. Knowles (M). Minerals from Isle of Man, and Harz Mountains; by Mr. Wilson.

Prize collection of Lepidoptera, (see Meeting, Oct. 3); by M. J. Michael (A).

Papers: on the '*Zoological Section*,' by B. R. Wise (M).

On the '*Drifts exposed in the Lawford Road*,' by R. D. Oldham (M); see Report of Geological Section.

On '*Bees*,' by H. Vicars; the Paper is subjoined.

'I'm going to say a few words about bees. Everybody knows what bees are, so I need not describe them; but everybody may not know their manners and customs, their political principles, or their behaviour in social life.

'In every hive of bees there are 3 kinds of individuals—a queen, drones, and workers. The queen is a female, and moreover the only female allowed to live at liberty in the hive. She is the mother of a greater part of the hive, and her sole occupation is in laying eggs: but owing to the majestic slowness of her movements, this operation is rather a lengthy one, so she has to go on all the year round incessantly depositing single eggs. She is always attended by a body-guard of 12 workers, whose duty it is to protect her, to feed her, to make her lay her eggs in the right cells, and to prevent her getting into any mischief, such as killing the young queens or stealing the honey, etc. She does not seem to be overburdened

with sense or discretion, but still the workers hold her in great respect, and never venture to profane her dignity till duty calls them to protect the hive against her unprincipled amusements, and even then are obedient to her voice of sovereignty, which consists of a squeak. This guard is never intermitted, but often changed. For 4 months the queen lays only worker's eggs, afterwards those which are to produce drones, and every now and then (perhaps once in 3 days) an egg that is to produce a queen. The maggots are hatched in a few days, and are fed and nursed by the workers with great care. In about 6 days each maggot fills up his cell; it is then roofed over by the workers and left to its own devices, which generally consist of spinning a cocoon, and turning into a chrysalis as soon as possible. They emerge in about 3 weeks.

'But to return to the queen. Sometimes it happens that she dies, or is killed, or is taken away. At first the hive does not seem to find out that she is gone, but when the knowledge of her decease or departure becomes generally known, the excitement is intense. All work is abandoned, and the astonished inhabitants of the hive rush about without any sort of aim or object; in fact, a complete state of anarchy reigns for sometimes as long as 2 days. Towards the end of this time the workers may be seen in groups of 12 or 14, apparently deliberating. Their minds are soon made up, and when 3 or 4 workers have been despatched to prepare a royal cell, the business of the hive goes on as usual. One egg is selected, destined to be a queen, and is nursed with the greatest care. The maggot is fed with food only given to royal maggots, called royal "bee-bread." In 16 days the longed-for queen appears, and is hailed with every sign of delight. A queen does not reign generally in one hive for more than a year, for the old queen generally heads the first swarm for the season. It is curious to notice how cultivation seems to have deadened their natural instinct in one way, viz., instead of choosing some hollow tree or other shelter for their nest, hive-bees will form their swarms on the first green branch that comes in their way.

'*Workers* are abortive females, whose business it is to build the hive and to collect honey. They are like the queen in appearance, only much smaller. As many people know from unpleasant experience, they are provided with stings.

'*Drones* are males; they are totally useless in collecting honey, and are not armed with stings. They have only two wings to all appearance, though there is a pair of the smallest possible dimensions, in place of the other full-sized pair. When they are no longer wanted towards the end of autumn, the workers put an end to them. The operation is as follows. A buzzing noise is heard in the hive, and the drones and workers fly out together; they grapple with one another for a moment in the air, during which time the workers employ their stings upon the bodies of the unhappy drones. The latter soon succumb to the poison, and fall dead outside the hive.

'I will now go on to say what my experiments (if they deserve so high a title) have shown with regard to the notes sung by bees.

'I remembered having heard a story about some mediæval divine (I rather think S. Augustine) who made an organ of pigs. He found out the different notes that they squeaked, and having selected the individuals with the best voices, he shut them up in separate tight-fitting boxes. He arranged them in proper order according to their notes, packing them as close together as possible. He then constructed a key-board with long levers, which were each connected with a pig-box; at the end of each lever there was a pin or some other sharp-pointed instrument, which, when the corresponding key at the other end was pressed down, ran into a pig. The result may, I think, be imagined better than described. I don't at all understand how he succeeded in persuading the pigs to stop squeaking when he wanted to produce another chord, nor even how he persuaded such obstinate animals always to squeak the same notes. I should fancy he did *not* succeed.

'This story suggested to me the possibility of making an organ of bees. To do this of course first I had to find out their notes, and in *this* I succeeded very well. I got an octave of bees, and with them I determined to make trial. I intended to do very much as S. Augustine did with the exception of the pin, which was substituted by a fine piece of cotton attached to one of their hind legs; but the creatures could not be induced to live for more than a day, though I gave them abundance of food: so my scheme was spoilt. I told Mr. Sidgwick of what I had been trying to do, and he suggested that as I could not get my bee-organ, I could at any rate get the different notes of bees and register them. I acted upon this as far as I had time and opportunity, and I now produce a few specimens of my labours. My series is very incomplete owing to some having been lost or destroyed; but still even as they are they may show something. I always took the notes when they were in full flight, so as to get as near as possible to the average. An irate bee sings a higher note than a bee in a good temper. This by the way reminds one of the fact that human beings are rather given to speaking in higher and louder voices when they are in a rage. Of course as a general rule, the larger the bee the lower its note; but this is not always the case, owing I suppose to the greater activity of some individuals, and laziness or weakness of others. The notes obtained vary from the middle B to the B above. It will be noticed that the individual who sang the lowest note is far from being the largest; in fact he is only a drone. One would have expected these to have sung higher notes, but as a general rule they seem inclined to be "lowish." I *did* get one whose powers of singing passed all comprehension. He began by singing an F two octaves below the only other F I have got, viz. the middle F; he then rose gradually and sang the octave above the note on which he had begun. Having ascended about 3 notes higher he began to go down again, and went back to his original note. I can only account for this by supposing that he was seriously unwell. As a general rule a bee can sing over a whole tone; some however are more expansive, some less.

'It might be interesting to know the number of vibrations which produce some of the notes mentioned.

'The lowest note B is produced by			121	double vibrations	per sec.
C	,,	,,	128	,,	,,
D	,,	,,	144	,,	,,
E	,,	,,	161	,,	,,
F	,,	,,	171	,,	,,
A	,,	,,	215	,,	,,
B	,,	,,	242	,,	,,

'The individual whose ill-health compelled him to sing the lowest F made 43 double vibrations per sec.

'That is to say, that each of these numbers doubled will give the actual number of muscular movements produced by a bee in one second; always supposing, (what has been disputed) that the sounds are produced by the vibrations of the wings.

'If then a bee's hum is C it produces			256	muscular movements	per sec.
E	,,	,,	322	,,	,,
A	,,	,,	430	,,	,,
B	,,	,,	484	,,	,,

'If anyone can invent a method for keeping bees in confinement alive and active, I think it will be quite possible, within certain limits, to make a bee-organ; and that with the advancement of science even the most refractory bees will be able to be educated into singing properly. Until then the bee-organ must, I suppose, be to us as much a thing of impossibility as S. Augustine's pig-organ.'

MEETING HELD NOV. 7. (36 present).

Exhibitions: Plants from Scotland, by Mr. Kitchener, who observed that the Campions on Ben Lawers were attacked by the same parasite as in Rugby.

Papers: on '*Silkworms*,' by E. J. Power (M). The Paper dwelt on the methods of hatching, feeding, spinning, and unwinding the silk.

On '*Roman Remains near Church Lawford*,' by L. Knowles (M). This Paper we give *in extenso.*

'Last summer an old associate of this society started with me in quest of fossils, of which we had heard there were plenty in a pit near Lawford. After walking along the road for some time we arrived at the village, where we were directed across some fields to a small gravel pit. We surveyed the place for some time, and were astonished to find that there was nothing to be obtained there, at least so we imagined, except gravel. Whilst walking about I discovered, lying on the ground, what appeared to me to be the top of a very old haymaker's jug. I was about to throw it into some water close by, when a thought struck me that it might possibly be something old, perhaps Roman. It was by this nearly 3.30 P.M., and as calling-over was in those days at 4 P.M., we had no time to

look about for more fragments, but had only just time to reach the School and miss our names.

'Upon taking this curiosity to Mr. Bloxam, the Rugby antiquary, we were told that we had discovered the first Roman remains in the neighbourhood of Lawford, and that our fragment was the neck of a "præfericulum," or jug, from which blood, mixed with milk and wine, was poured out at funeral libations. A few days after this we went again to the same spot, expecting to find some more Roman remains, as we were told that in all probability there was a Roman burial-place close by. However we were unfortunate, owing probably to workmen who might have destroyed the other remains in that particular part. This summer Mr. Bloxam's nephew stole a march on me, and by means of my careful description of the locality went to the superintendent of the works, from whom he obtained what the man called an old ink-pot, and certainly it was like one. As soon as I saw this supposed ink-pot, and heard from whence it came, I guessed that it must be a Roman lamp, which surmise eventually proved to be correct. Mr. Bloxam said that it was a real lamp of "red-glazed" ware, the most perfect yet found in England, and that he had never seen one exactly like it. It is about 5½ inches in diameter at the bottom, 4 inches at the top, and 3 inches in height. Its sides are not perpendicular, but curve inwards. On the top are two holes, one in the centre about the size of a shilling, down which were put the wick and oil, and the other, which is smaller and nearer the rim, is where the wick protruded for lighting. It is nearly the colour of an ordinary flower-pot, and most probably came from the Caister (Northampton) potteries. Soon after this a fellow from our house set off with me to see if we could find any more pottery in the neighbourhood of my first discovery. We went all over the gravel, and at length found in the side of a pit a patch of black soil, about 6 feet deep and 4 feet wide. Into this we dug, or rather poked with an umbrella, and had the satisfaction of finding several bits of dark brown pottery, also the side of a red-coloured vessel with a pattern of a double row of white spots on each side of it. We were not allowed to dig into this soil, as the workman there told us that the bank would be washed down by rain if we undermined it. All this soil in which we found the pottery was burnt, and quite of a different nature to sand and gravel on either side of it. The stones too were most of them quite pink with the action of fire, and there were many bits of flint amongst them. On the first Saturday of this Term we went again to our diggings, and this time got a very perfect bit of the rim of a cinerary urn, of a very rough and brown ware. The man on this occasion did not seem so averse as on the previous visit to our work, but let us dig out nearly all the black burnt soil. He told us that the men had come to several such patches, and had found bits of pottery, but had thrown them away as rubbish. Whilst digging we came upon a partially burnt stone, which evidently came from the drift, and which is split in such a way that it seems to be artificially made. This, we imagine, to be the instrument with which the urns were made.

'The black earth begins at 18 inches below the surface, and to prove that the Romans did bury their dead near the surface of the ground, I have been given the quotation, "Sit tibi terra levis." They most probably dug a hole in the ground, into which they placed the cinerary urn, with vessels and utensils around it, and then lit a fire round them; by this means filling up the hole with black cinders, which have now become a kind of rich soil.

'About the year 1814 some labourers in digging for limestone in the township of Little Lawford, on the estate of John Caldecott, Esq. of Holbrook Grange, discovered a well or circular cist formed of limestone, about seven feet deep, at the bottom of which were deposited three Roman urns, filled with burnt bones. The spot where they were found was on the north side of the Avon, about a mile south-east of the spot on the east side of the river where my fragments of Roman pottery were discovered. About 14 or 15 years ago the upper stone of a Roman quern or mill was also found thereabouts.

'On the north bank of the river Avon, at Newnham Regis, Mr. Bloxam discovered some years ago traces of a British settlement, and near the site of the demolished church, and about half a mile from the ancient British Trackway, called the Foss Road, was a tumulus, levelled some years ago. This appears to have been in connection with the very perfect ancient British camp at Brinklow, a frontier fortress of the Coritani. Though all this is not Natural History, yet I thought some of the members or associates of this Society might not be uninterested in hearing that there are remains of the Romans to be found within a short walk of Rugby.

'The Roman lamp and praefericulum are drawn on Plate 4, fig. 1.'

MEETING HELD NOV. 21. (64 present).

Exhibitions: Drawing and photograph of scenes in the Harz mountains; Geological specimens; by Mr. Wilson.

Fossil fish from the Sierra Nevada; curiosities from Fiji; by W. B. Thornhill (A).

Mr. Wilson then presented the following Papers.

Note on the Gravel-pit between Clifton Road and the Stamford Line; by W. B. Lowe (O.R.)

Catalogue of the German collection of Rocks in the Arnold Library, arranged according to Cotta; by F. T. S. Houghton (O.R.)

Report on the Rugby School Museum sent to the Science Commission. [This will be found at the end of our Report.]

Supplemental Catalogue of Bench-marks in the neighbourhood of Rugby. [This also will be found at the end of our Report.]

Papers: by H. W. Trott (M) on the '*Shamrock.*'

This Paper examined the various claims of different known plants to be identified with the shamrock.

He also said a few words about the work of the Botanical Section.

By H. F. Newall (A) on '*Drops of Liquid.*'

'As is so often the case, it was an accident which gave rise to the experiments of which I am about to describe the results.

'I had been drawing some curves with a "Compound Pendulum" on some smoked glass, and wishing to print some photographs from them, I had to fix the coating of smoke; and so I poured a film of collodion on the glass. Whilst doing so I accidentally let fall a drop from a slight height on to the glass. The mark on the smoke made by the drop attracted my attention (my father also claims to have first noticed it), and I was induced to try another drop. Accordingly I did so, and got the most curious result. All the coating of smoke, where the drop fell, was removed except a little dot in the centre. I tried again, letting fall the drop however from a greater height, and got a more distinct dot; for this time it had a ring round it, and outside this ring was another lighter ring. The drawing (Plate 5, fig. 1) shows roughly the form of the drop. The jagged edge of the outside of the drop is easily accounted for, but the dot and rings in the centre are very curious. Unable to make anything of it I showed it to Mr. Hutchinson, who showed it to Mr. Wlison. They both proposed the idea that the bottom of the drop was indented so to speak by the resistance of the air, so that the bottom of the drop in section would appear as shown in fig. 2. But this seems disproved by the fact that I have got one in which the inmost spot, which appears to be a dot in the others, is in reality a ring, that is to say, it has a white spot in the middle of it. And I think this tends to show that the drop is not indented by the air: for the air would make a *hollow* in the centre of the bottom of the drop, whereas in this case it would seem that there is a *point of water* in the centre. However I have had only one of this kind, so that there is scarcely sufficient proof.

'Mr. Wilson advised me to try the experiment in vacuo. This I did, but gave it only a very small chance as I could only get a fall of 1½ feet, whereas I have generally had one of 7 feet in the air. And, besides, I could not get a perfect vacuum. But under these disadvantages I got practically the same results in vacuo as in the air.

'I have tried with different liquids, but principally with oil: for it seems the thicker the liquid, the more distinct the dot. Spirits of wine gives practically the same results as oil, but far less defined. Water thicker than spirits of wine, thinner than oil, gives a result between the two.

'A very curious thing happened whilst I was painting the figures. I had got my brush full of black paint and water, and whilst shaking the water off a drop fell into a glass of clean water, and I was astonished to see a ring of black paint gradually growing larger as it

fell to the bottom of the glass (fig. 5). On looking straight down on to the ring I saw a dark little spot in a nebulæ of black paint, so to speak, floating directly above the ring. I tried a second time, and got the same result. And naturally putting the two cases together, I imagined that the nebula in the water corresponded to the large circle with the jagged edge on the smoked glass, the little black spot to the inmost dot, and the ring to the one round the dot in the smoked glass. I do not know whether this has been noticed before, but it certainly coincides very curiously with the results I have obtained on the smoked glass.

'It occurred to me that as I had got a case in the smoked glass, in which what seemed to be a dot in others was in reality a second ring, the spot in the nebula might also be a ring. After trying several drops, I succeeded in getting one in which there was a distinct ring above the one which had fallen to the bottom of the glass. I got two drops in which this occurred, so that there was more proof than in the case of the smoked glass. I also noticed that there was a line of black joining the two rings, gradually getting thinner as it got to the lower one.

'I have brought with me two rough drawings of some of the dots in drops on smoked glass, which are of course greatly magnified, being about twelve times the size of the original, (figs. 3, 4).'

By W. Larden (O.R., C), read by B. R. Wise (M) on '*Cuckoos.*'

'This year there have been so many cuckoos about, that I have rarely, if ever, taken a walk in the country without seeing one or more of these interesting birds; so that I have had many opportunities of observing them, more or less. I have once seen two together, and once two sets of three closely following each other. The locality they chiefly favour is that part between Bilton and Lawford.

'I will first give some of their better known habits and appearance, and will then notice more curious traits. (1.) In flight they look just like a hawk as regards their straight long tail and anchor-shaped wings; but they never hover; keeping up a perpetual quick vibration of their wings, and holding a straight course. They do not flap their wings, like a pigeon, and do not usually expand their tail. (2.) They are fond of changing from tree to tree, uttering their cry generally as they fly, and almost always directly they alight. (3.) Towards evening you sometimes see them in tall hedges; perhaps they roost there.

'I will now give some curious observations I made last night. I was going along the lane between Bilton and Lawford, when I noticed three birds approaching that I easily recognised as cuckoos. I therefore instantly stopped still and watched.

'They came in a line, with the usual hawk-like appearance and straight tail. As they passed—from alarm?—they made a curious sound more like what a blackbird makes when it hears a suspicious sound about dusk—a quick warning hick-hick-hick, repeated in a run 6 or 7 times in a sharp unmusical tone. Then they alighted

in a tree close by, and repeated it at intervals. Soon I heard a medley of cook-cook-coók-oo, cook-cook-coók-oo, as though two cuckoos were trying to shout each other down. At first I thought it must be some little boy imitating and frightening them; but afterwards I found it was not. Then I saw *three more* cuckoos coming towards me on the other side. Then one disappeared and two came on, and began chasing each other round the trees—coming quite over my head—making a most curious *hissing* noise, like an angry cat, at each other, expanding their tails as they darted round corners. Then one settled in a tree behind me, and cook-oo'd. But when one of the first three set up its warning cry, hick-hick, etc., this one too stopped its usual note and answered. Meanwhile the other of these two was in a tree, practicing its cuckoo, saying cook- cook- softly to itself now and then, and then loud cookóo. After this some of them went one way, some another, and one or two retiring to a tree further off began as before, shouting at each other in a wrangling manner,

{cook-cook-cóok-oo
cook-cóok-oo, cookoo}

I do not know whether it is generally known that the cuckoo has two other sounds besides cookoo,—the hissing noise and the warning blackbird-like cry.'

REPORT OF SECTIONS FOR 1874.

Meteorological Section.

The meteorological observations have been carried on as usual, and there is nothing calling for special remark. The names of the observers are given below.

F. W. Dutton	L. Knowles	G. Varley
R. S. Gunnery	W. Larden	H. Vicars
F. T. S. Houghton	R. D. Oldham	H. F. Wilson
J. C. Hurle	E. J. Power	A. Wise
H. N. Hutchinson	G. A. Solly	Mr. Kirk (during the vacations).
G. L. King		

Meteorological Observations.

January.

Date	Barom. Re-duced.	Temperature Dry Bulb	Wet Bulb	Max.	Min.	Rain — Inches	Date	Barom. Re-duced.	Temperature Dry Bulb	Wet Bulb	Max.	Min.	Rain — Inches
1	30,037	36,4	36	49,6	34	,07	18	29,644	40	40	43,2	30	,11
2	29,825	48	47	49	38		19	29,653	44	43	51	40	,27
3	29,391	43	41,4	49	38	,12	20	29,591	50,2	47	51	40	,06
4	29,517	32	31	45	31	,06	21	30,081	39	38	52	37	
5	29,974	33,8	33	39	31,4		22	30,447	31	31	50,4	30,2	,01
6	30,291	35	34	39,8	29		23	30,227	42,4	42	44	37	,23
7	30,221	35,2	33,8	44	32,6	,23	24	30,170	40	39,8	48,4	39,2	,02
8	29,823	35,4	34,8	41,2	32	,20	25	30,613	33	32	42	28	
9	29,728	46	45	46,4	35	,38	26	30,397	41	39	44,2	32,2	
10	30,032	42,6	42	47	38	,19	27	30,493	40,4	39	49,8	40	
11	30,149	30,6	30,2	45,8	28	,04	28	30,563	44,8	42,8	48,2	39	
12	29,837	45	44	45,4	35	trace	29	30,412	40,2	39	46	39,8	
13	30,128	33	32	46,4	31	,01	30	30,439	38	37	42,8	38	
14	29,951	43,2	42	45	32		31	30,534	38,6	37,4	46,8	32,8	
15	29,859	47	45	48,6	44,8	,01	Average						Total
16	29,463	46,2	45	49	43	,20		30,033	39,59				2,35
17	29,532	32	31	48	31	,14							

February.

Date	Barom. Re-duced.	Temperature Dry Bulb	Wet Bulb	Max.	Min.	Rain — Inches	Date	Barom. Re-duced.	Temperature Dry Bulb	Wet Bulb	Max.	Min.	Rain — Inches
1	30,515	43,2	41,5	45,2	39,1	trace	17	29,400	42,8	42,1	45,0	37,1	,01
2	30,443	42,0	40,3	45,2	37,5	„	18	29,560	33,1	32,4	45,2	30,7	trace
3	30,404	39,3	38,9	44,5	37,5	„	19	29,949	33,2	32,9	43,3	31,4	
4	30,656	30,0	29,5	47,1	28,2		20	30,240	24,8	frozen	46,2	23,0	,01
5	30,632	28,7	frozen	42,0	23,1		21	30,098	38,8	37,3	38,9	24,3	,02
6	30,519	15,5	„	30,0	15,3		22	29,805	42,8	42,0	43,0	38,2	,44
7	30,342	28,2	„	28,2	23,5	,03	23	29,895	38,8	38,2	38,8	37,9	,02
8	39,150	38,9	36,8	42,1	35,7		24	30,449	35,8	35,4	36,2	31,3	trace
9	30,430	24,0	frozen	41,8	23,5		25	29,926	32,8	32,1	32,8	31,6	,06
10	30,538	28,9	27,8	37,8	25,7		26	29,217	43,2	42,3	43,4	36,8	,43
11	30,431	21,2	frozen	31,4	19,5		27	29,151	38,6	37,8	38,6	37,2	trace
12	30,052	26,1	„	32,8	22,7	,07	28	29,976	37,4	36,7	37,8	31,2	,01
13	29,975	42,3	41,0	44,8	26,5	,02	Average						Total
14	29,689	47,1	44,6	48,1	40,8	,25		30,033	35,2		52,8		1,80
15	29,392	45,3	44,0	52,8	42,5	,07							
16	29,392	44,1	43,2	50,5	41,5	,36							

March.

Date	Barom. reduced.	Temperature Dry Bulb	Wet Bulb	Max.	Min.	Rain — Inches	Date	Barom. Reduced.	Temperature Dry Bulb	Wet Bulb	Max.	Min.	Rain — Inches
1	29,870	45,8	44,3	45,8	36,5		18	30,032	47,6	47,2	53,5	45,5	
2	30,335	44.8	44	48	42		19	30,059	41,8	39	59	33	,06
3	30.603	34,5	34,5	36,3	33,5	trace	20	29.987	43.5	39	49,2	37,8	
4	30,574	38	37,8	42,8	34	trace	21	30,111	44	41,2	48,5	37,5	
5	30,572	41	39	44,5	37		22	30,042	50	48	53,2	43,2	trace
6	30,739	40	38,5	54	38,5		23	30,284	47,8	47,5	53	45	trace
7	30,640	37	36,2	52,5	31		24	30,310	49	46	67,5	43	
8	30,135	32	frozen	54,5	27	,08	25	30,483	40,5	38,8	58	33	
9	29,637	31,7	32	49,5	30	,17	26	30.390	36,8	35,2	56,5	34	
10	29.651	28,5	frozen	37	23	,07	27	30,024	45,5	42	50	34,6	,01
11	30,012	25,5		35	19,5	,03	28	30,092	46,2	43	61,5	37	,07
12	30,109	28,7		35,2	23	,10	29	29,738	53,5	49	57	45,2	,03
13	30,376	38,3	37,5	42.8	32.5	trace	30	29,356	46	42,8	55	42	,06
14	30.502	43.2	40,5	45	37,5		31	29,771	51,2	49,5	55,5	45	,05
15	30,343	46,8	44,8	48	43								Total
16	30,306	45,8	44	49,4	43	,02	Average		41,7		67,5		,87
17	30,180	49,5	48	54	45	,12							

April.

Date	Barom. reduced.	Dry Bulb	Wet Bulb	Max.	Min.	Rain — Inches	Date	Barom. Reduced.	Dry Bulb	Wet Bulb	Max.	Min.	Rain — Inches
1	29,994	46,8	42,4	55,8	36	trace	18	29,985	52,4	52	54	45	,01
2	29,635	50,4	47	56,2	43	,16	19	30,108	54	51	59	46	
3	29,261	45,2	41	58	43	,02	20	30,109	53,2	49	61	41,8	
4	29,418	42,4	40	53	34	,04	21	29,978	59,8	55	65	40	
5	29,442	43,6	41	50,4	35		22	30,113	53	51	75	43	
6	29,758	46,8	43,2	56	34		23	30,144	54	51	64,2	4	
7	30,032	48	43	58	35	,06	24	30,137	58,8	55,2	72	48	,01
8	29,882	46	42	56,2	38,8		25	30,162	58	56,2	67	51,8	
9	29,656	46	43,4	57	36,8	,45	26	30,174	62	57,8	64	52,8	
10	29,269	43	42	47	39		27	30,234	50,8	50	73,6	45,8	
11	29,264	44	41	55	30,2	,04	28	30,289	56	52	74,2	45	
12	29,555	44	42	54	37,8	,02	29	30,370	47,8	44	65,2	33,8	
13	29,344	40	38	52	32,8	,11	30	30,050	52	47	60,8	36,4	
14	29,736	43	42,2	53	38								Total
15	30,139	42	41	52,4	41	,17	Average	29,875	49,27	46,32	57,41	39,98	1,20
16	30,019	48	46,2	55,4	41,8								
17	30,005	47	43	58	42	,11							

May.

Date	Barom. reduced.	Dry Bulb	Wet Bulb	Max.	Min.	Rain — Inches	Date	Barom. Reduced.	Dry Bulb	Wet Bulb	Max.	Min.	Rain — Inches
1	30,053	45	41,5	69,8	40		18	30.302	49,8	43,2	63,2	32,6	
2	30.168	45,1	44	57,8	31,5		19	30,313	50	47	65.9	44.7	trace
3	29.907	46.1	41	54,5	34	,05	20	30,288	48,5	45	55.4	44.2	
4	29.880	44	40	55,8	34		21	30,086	48,7	44,8	53,6	43	,05
5	29.970	44	41,2	53	39	,02	22	29,708	49,8	48	64	44	,10
6	29.864	49,2	44	53	36	,01	23	29,563	48,5	48,1	64	45	,21
7	29,727	45,2	42,8	57,8	37	trace	24	29,553	53,5	52,5	55,8	48	
8	29,683	44	41	54	35,2	,15	25	29,851	54,5	54	64,1	48	,57
9	29,885	43,5	40,2	54	31	trace	26	30,004	53	51,2	70,1	49	
10	29,907	46,5	41,8	53	35,5		27	30,051	58,2	54,5	64	49	
11	30,114	47	43,7	53	34,2	trace	28	29,982	59,5	56,2	68,5	53	
12	38,222	46,5	42.1	53,2	35,7		29	29,984	57,6	55	68	53,2	,03
13	30.370	46,9	44.1	52,9	40,5	,09	30	29,846	55,8	52,9	64	49	
14	30,396	44,4	43,2	55,7	43,2	,16	31	29,992	59,3	55	67	53,5	
15	30,078	45	43,5	53,3	44	trace							Total
16	30,405	46,7	41.5	53,3	32,1		Average	30,018	49.2	46,05	59,0	41,02	1,44
17	30,355	49,6	44,5	57,5	32,5								

June.

Date	Barom. Reduced.	Temperature Dry Bulb	Wet Bulb	Max.	Min.	Rain — Inches	Date	Barom. Reduced.	Temperature Dry Bulb	Wet Bulb	Max.	Min.	Rain — Inches
1	30,112	61,2	56,2	67,8	54,4		18	30,311	48,6	47,8	56,2	47,7	
2	30,024	62,5	58	[illegible]	50		19	30,300	50,6	[illegible]	51	45,1	
3	30,132	[illegible]	[illegible]	73,5	53	trace	20	30,226	52,8	49	71,8	49,2	
4	30,454	[illegible]	56,1	70,5	47,8		21	30,107	51	47,9	53,6	44,5	
5	[illegible]	62,2	57	75,8	46,8		22	29,967	[illegible]	55,1	69,8	50	
6	30,148	62,2		74	54,5		23	[illegible]	57,6	52,3	73,1	50,1	,01
7	30,210	58,7	56,5	67	43,5	trace	24	29,820	56,8	52,7	[illegible]	[illegible]	,02
8	30,258	59,7	51,5	73,1	42,8		25	29,786	55,3	52,5	65,7	47,9	,11
9	30,180	62,5	57	72,1	47,5		26	29,694	57,4	54	69,2	[illegible]	trace
10	30,156	[illegible]	54,7	78,8	55,4		27	29,638	53,6	52	62,9	44,5	
11	30,210	58,5	51	68	41		28	[illegible]	56	54,5	72,3	50	,01
12	30,405	50,7	45,6	74 6	40,5	trace	29	29,946	55,1	[illegible]	72	48,9	,51
13	30,447	48,8	43,2	54,3	36,1		30	[illegible]	60	55	66,2	50,2	,07
14	30,450	51,4	45,2	60,5	40								
15	30,607	[illegible]	[illegible]	59,7	39,8	trace	Average						Total
16	30,372	51,2	43,1	63,2	47	,01		30,145	56,08				,75
17	30,214	48,7	47	[illegible]	47,1	trace							

July.

Date	Barom. Reduced.	Temperature Dry Bulb	Wet Bulb	Max.	Min.	Rain — Inches	Date	Barom. Reduced.	Temperature Dry Bulb	Wet Bulb	Max.	Min.	Rain — Inches
1	29,975	59,2	57,1	69,1	56,7	,03	18	30,278	65	58	[illegible]	[illegible]	
2	[illegible]	67,7	[illegible]	67,7	53	,01	19	30,151	61,2	58,8	82,2	47,8	
3	29,919	63,4	[illegible]	82,7	55,1	trace	20	29,934	67,4	62	85,2	[illegible]	
4	30,007	59,8	54,2	70,2	52	,01	21	[illegible]	64	58,4	85	55	,04
5	30,275	61	58,1	69,1	[illegible]	[illegible]	22	29,900	[illegible]	56,2	77	54	,01
6	30,319	58,5	53	75,1	44,3		23	[illegible]	60	57	71,6	51,2	
7	30,183	58,3	54,2	[illegible]	[illegible]		24	[illegible]	[illegible]	57	74,2	[illegible]	,01
8	29,271	[illegible]	57	73,9	53,1		25	29,952	[illegible]	55	70,2	[illegible]	,18
9	30,140	[illegible]	[illegible]	80,9	51,7		26	[illegible]	56	55,8	74,4	52	trace
10	30,137	67,4	61	[illegible]	57,1		27	29,715	61	[illegible]	72,2	50	,18
11	30,039	[illegible]	59,7	[illegible]	57,3		28	29,622	[illegible]	[illegible]	67,2	52	,09
12	30,037	62.5	[illegible]	74	[illegible]		29	[illegible]	61,8	57,8	69	52,4	
13	30,103	66,6	62,1	79,8	[illegible]		30	[illegible]	[illegible]	58	74	[illegible]	
14	30,026						31	30,034	63	58,2	74,8	[illegible]	,06
15	30,143	66	60,6	78	[illegible]		Average						Total
16	30,221	[illegible]	[illegible]	[illegible]	67			29,974	62,76				,65
17	30,271	63	58,2	80,6	57								

August.

Date	Barom. Reduced.	Temperature Dry Bulb	Wet Bulb	Max.	Min.	Rain — Inches	Date	Barom. Reduced.	Temperature Dry Bulb	Wet Bulb	Max.	Min.	Rain — Inches
1	29,910	59	57,8	73	56				55	53,2	65,8	[illegible]	,01
2	29,759	65,4	62,2	71,2	[illegible]				66,8	63	69,2	54,8	
3	29,890	59	53	77	49,8	,05			68	63,8	76,2	54	
4	29,866	53	52	69,4	49	,16			60,2	58	83,2	57	
5	29,804	52,6	[illegible]	62,8	[illegible]	,09			59	55	73,2	44	
6	29,836	57,8	51,2	[illegible]	[illegible]				58,4	56	76	47	
7	29,766	61	59	69,2	47,4	,16			57,5	53	74,2	[illegible]	
8	29,607	[illegible]	55	72,4	50	,02			64	59	72,8	57	
9	29,801	[illegible]	52	68	51,8	,03			58,8	55,4	76,2	46	
10	29,526	[illegible]	56	[illegible]	54	,46			58	56,4	71,8	53	,20
11	29,624	[illegible]	51	68	49	,01			56,8	54	67	45,8	,03
12	29,692	56,4	60	63,8	47	,20			51	50,4	[illegible]	49	,13
13	29,523	57,4	56	67	53,8	,31			58	55	62	46,8	,04
14	29,382	55	53	65	52	[illegible]			60	56,8	67,2	56	,16
15	29,962	57	53	63	50								
16	30,016	59	57,2	[illegible]	55	,15			58,5				2,26
17	30,149	57,8	54	66	[illegible]	,01							

Date	Barom. Reduced.	Temperature Dry Bulb	Wet Bulb	Max.	Min.	Rain — Inches	Date	Barom. Reduced.	Temperature Dry Bulb	Wet Bulb	Max.	Min.	Rain — Inches
						September.							
1	29,594	65,4	62	70,2	67,8	trace	18	29,896	65	53	63,2	46	
2	29,827	60,2	55,8	70,2	52,8	,05	19	30,021	65,4	52	61	43,2	
3	29,898	56	55	70	51	,31	20	29,915	58	56	61	53	,06
4	29,842	54,8	50,8	61,8	50,6	,08	21	29,624	61,6	59	63,4	54	,02
5	29,999	55	52	63,6	45		22	29,734	58	53,2	65,8	50	trace
6	29,980	52,8	52	67	49,6	,13	23	30,006	52	51,8	63	47,2	
7	29,992	57	55,6	57	52	,03	24	30,137	56	55,4	66	48	trace
8	29,958	60	57,8	64	53	,18	25	30,215	61	58	63,8	51	
9	29,537	51,8	51	64	51	,26	26	30,220	59,8	58	71,2	52,2	
10	29,525	54	49	61	43	,37	27	30,000	58	57	77	47,8	
11	29,685	52,4	51	62,2	45	,41	28	29,802	59,8	57	77	54	,06
12	29,618	55,4	52	59	49	trace	29	29,655	57	54	66,6	52	trace
13	30,175	54	51,8	63,8	40	trace	30	29,788	53,8	50	63,2	45,8	,10
14	30,352	55,4	52,8	61	43	trace							
15	30,137	54,8	51,2	65	48	,20							Total
16	30,018	57	57	62,8	53,8	,90	Average	29,902	56,35				3,16
17	29,919	50,2	50,2	57,6	48	trace							
						October.							
1	29,446	57,5	54	62,5	49,5	,09	18	29,955	49	48,5	54	44	
2	29,356	51,5	50	63	41,5	,03	19	29,743	50	49	56,5	48	
3	29,246	49	39,5	56,5	47		20	30,203	40,5	40	59	35	,01
4	29,445	48,5	40	53,5	44,5		21	29,510	58,5	50,5	54	40	,03
5	29,963	44	41,5	57	38		22	29,730	44,5	41,5	54	40	
6	29,871	45,5	43	63,5	38	,75	23	29,960	38,5	37,5	54	39	
7	28,968	50	49,5	54	45	,17	24	30,132	45	41,5	51	37	,01
8	29,931	45	42	56,5	37	,80	25	29,869	57	55	58	44,5	,10
9	29,797	51,5	51	55	40,5		26	30,098	56	55	60	50	,14
10	30,046	50	48	64	48		27	30,028	54	53	56	49	,30
11	30,111	56,5	54,5	60	49		28	30,064	54,5	54	60	53	,02
12	30,160	50,5	50	62	46		29	30,058	50	50	55	48	,70
13	29,912	57	54	60	49		30	30,241	49	48,5	54	47,5	,18
14	29,912	49,5	49	61,5	48	,40	31	30,337	48	47,5	50	40,5	
15	29,420	58,5	57,5	58	49,5	,35							Total
16	29,738	50	49,5	64	50	,08	Average	29,840	50,21				4,23
17	29,821	47,5	46	55	41	,07							
						November.							
1	30,156	45,8	44,6	50	41	,165	18	29,888	50	49	50,5	41,9	,07
2	30,106	46,9	46,5	47,4	44,5	trace	19	29,776	46,3	44	53,8	44	,1
3	30,112	42,8	42,4	53,8	40,4		20	29,923	39	37,9	42	38,5	
4	30,133	42,1	41,9	57,8	40,5	trace	21	30,135	28,9	28,9	47	28,9	
5	30,085	50,1	50	57,2	41,5	,15	22	30,155	24,7	24,2	34,9	21	
6	30,299	48,2	48	53	46	trace	23	30,145	25,5	25,4	25,3	24	
7	30,317	41,7	41,2	51,6	37		24	30,235	25,4	24,9	25,1	23,5	,11
8	30,529	37,7	37	55	30,5		25	30,001	37,2	36,9	37,2	24,8	,17
9	30,278	50,4	50,1	50,4	37		26	29,933	30	29,6	30	30	,055
10	30,177	46,6	45,9	56	46		27	29,789	24,8	24,2	24,5	23,1	
11	30,259	31	29,9	48	28,5		28	29,672	31,2	31	31,2	24,4	,83
12	30,025	28,1	26,2	40,7	27	trace	29	28,599	40	39	40	31	,39
13	29,943	40,1	40	40,1	27,7	,01	30	28,942	35,4	35	35,4	34,9	trace
14	30,222	35,7	34,1	43,5	32,1	,13							
15	30,014	46	45,6	46	35	,025							
16	29,818	42,5	40,5	48,7	40	,26	Average	29,982	38,6				
17	29,791	43,8	43,1	51,3	41,9	,08							

There is an error in the December figures: see Preface.

December.

Date	Barom. Re-duced.	Temperature Dry Bulb	Wet Bulb	Max.	Min.	Rain — Inches	Date	Barom. Re-duced.	Temperature Dry Bulb	Wet Bulb	Max.	Min.	Rain — Inches
1	29,337	36,8	35,5	35	32		18	30,272	20	19,6	12,6	7	,06
2	29,845	27,8	27,1	24,1	18,1		19	29,911	34	33,4	19,6	19,6	
3	30,112	23,5	23,1	21,1	12,9		20	29,627	27,8	27	22	7	
4	30,106	33	35	23	20	,02	21	29,562	21,4	21,4	21	8	
5	29,700	47,5	46	35	33		22	29,800	27,8	27,8	21	9	
6	29,457	47	46	40	37	,08	23	30,029	18,8	18,8	19,8	18,8	,18
7	29,896	34	32	33	29	,05	24	29,537	32,4	32,4	18	17	,04
8	29,724	37	36	33	27		25	29,801	31	31	30,4	28,8	
9	29,262	38	37	37	35		26	30,001	31	31	25	16,2	,02
10	29,771	25	25	24	16	,14	27	30,204	29	29	24,2	19	,04
11	28,834	36	36	24	16	,07	28	30,276	30,4	30,4	24,8	19	
12	29,100	35	35	32	25	,06	29	30,246	23,8	23,2	21	19	
13	29,462	34	34	32	31,5		30	30,337	21,2	21,2	14,8	14	
14	29,961	33	31,5	31	28		31	30,279	20,2	20,2	16,8	13,6	
15	30,149	31	30	29	24								Total
16	29,689	30	29,5	28	27,5	,33	Average	29,821	30,6				1,11
17	30,167	30,6	30	28	24,2	,02							

Meteorological Notes.

1. Jan. 25. This evening there was a remarkably fine lunar halo. Three bright rainbow rings surrounded the half-moon, the radii of the rings being (by estimate only) 1½°, 3°, 4½°. A transparent cloud was drifting over the moon, and when it was gone the rings entirely disappeared.

J. M. Wilson.

2. On the evening of Friday, May 1st, between 8 and 9 o'clock, the somewhat rare meteorological phenomenon of a *paraselene* or 'mock-moon' was seen. The moon was full at the time and was in the south-east, about 20° above the horizon.

The sky was clear overhead, the clouds, consisting of stratus and cumulo-stratus, lying near the horizon, and to the east of the moon.

The paraselene was due south, in the same horizontal line with the moon, and appeared to be formed by a portion of a luminous circular arc intersecting a faintly luminous horizontal band, which extended some distance to the west of the mock-moon.

The blurred and indistinct image shewed iridescent colours on the east and west edges, varying in intensity every few minutes.

I expected to see a similar image on the other side of the moon, but nothing was visible.

Before 9 o'clock it gradually faded away.

The wind had been north-east all day, barometer rising about 29.8, and the air frosty.

During the night the thermometer fell below 32°.

T. N. Hutchinson.

Report on the Temple Observatory, 1874.

The instruments in use at the Observatory are the same as were enumerated in last year's report, and are all in good order; the damp however has somewhat attacked the 12½ inch reflector, which will have to be re-silvered.

The Observatory itself is in a very bad state of repair. During the heavy rain in the winter the wet got in to such an extent that it was found impossible to keep books or papers in the building. The reflector also suffered as above-mentioned.

The roof has also lost its circular form, consequently, in place of being rotated by one person, it is now considerable work for two to move it, and this renders it impossible for one observer to work by himself alone in the Observatory.

Temporary repairs are of little use, and substantial alterations are necessary.

As an application has been made to the Governing Body by the Headmaster for a site for a permanent Observatory, it is hoped that there will not be long delay before this is granted, and a new Observatory built.

Mr. Percy Smith has made and affixed to the circles of the refractor two small benzoline lamps, by means of which the R. A. and Declination can be read with much greater facility, and which obviate the necessity of carrying about a light as heretofore.

The greater part of the work of the Observatory has been done by Mr. Wilson, Mr. Seabroke, and Mr. Percy Smith, frequently with the assistance of visitors, in the measurement of position and distance of double stars, with a view to the calculation of the orbits of those that prove to be binaries. 421 stars have been measured, a large number of which prove to be in motion, and when one considers that each star takes up twenty minutes, it appears that this work alone has taken 140 hours—not to mention time wasted on cloudy nights.

In January Mr. Seabroke examined the spectrum of Sirius, and of a number of other stars. The sun-spots have also been watched, and their spectra appeared notably changed from what they were at the maximum sun-spot period.

Drawings of the sun's chromosphere have been made on 47 days by means of the ring slit and spectroscope. The number of available days has been much less than in previous years, owing to the prevalence of cloud.

On Feb. 4 a very bright display of Aurora was observed. The spectrum gave the line in the yellow, and traces of some 6 others more refrangible.

Many observations of Jupiter were made, and drawings taken.

Saturn also was frequently observed, and positions of the satellites observed on several successive nights.

In April several photographs of the moon were taken, which were well defined when enlarged to a diameter of 5 inches. H. N. Hutchinson's knowledge of photography was of great assistance in this matter.

Jupiter has also been photographed, and his belts were plainly visible in the negatives, but they were not considered worth keeping. Photographs were also taken of various double stars, but with no definite results.

Coggia's Comet was observed almost nightly during its presence in our hemisphere, and measures and drawings were taken. It was analysed on the 5th July by a spectroscope with a power of 4 prisms. The nucleus was found to give a continuous spectrum, showing either solid matter, or a liquid in a very compressed state. The fan surrounding the nucleus gave a faint continuous spectrum in addition to that

given by the tail, consisting of the three green bands, which have more or less been observed in all comets. There was a suspicion, but not more, of a fourth band.

A comparison was made with the spectrum of a spirit lamp flame, and the three lines to all appearance coincided. A number of drawings of the comet were also made, in which members of the School assisted. These have been published in the Monthly Notices.

Mr. Seabroke made a lengthy series of experiments with various forms of batteries, with a view to ascertain the best couples suitable for a permanent battery, to be used intermittently. Couples of platinised carbon and zinc, or of platinised lead and zinc, in dilute sulphuric acid, arranged Smee fashion, were found best. These may be put away for months and then be ready for use at a moment's notice. Twenty-two of these cells have been put up for trial.

Mr. Seabroke and Mr. Percy Smith have also constructed a heliostat, driven by clock-work, for the purpose of enlarging the photographs of the moon.

During the winter months Mr. Wilson has been going through the double star measures, and determining the places of the stars corrected for 1880, and copying them with a view to the publication of the last four years work.

The number of visitors to the Observatory during the year is 326, chiefly members of the School.

The Temple Observatory was visited in June, 1874, by the Bishop of Exeter, and other members of the Governing Body.

A few notes of no great importance have been published in the Monthly Notices of the Astronomical Society. Mr. Wilson has been elected on the council of the Society.

The net proceeds of the lectures on geology and optics given in the Lent Term of 1874 by Mr. Wilson and Mr. Seabroke were £16 10s., which has been put to the Observatory account.

Mr. A. M. Worthington, (O.R.), has kindly presented to the Observatory a 12 in. metallic speculum of 12 ft. focal length, made and polished by Mr. Brewin, of Leicester. As the focus is so long a telescope tube to contain it would be cumbersome, and it is therefore proposed to use the mirror on a fixed mounting in the Observatory, and reflect the light from the object on it by means of a siderostat.

G. M. SEABROKE.

Geological Section.

Contributions to the Local Museum.

A collection of minerals from the Vaal river, Cape of Good Hope Diamond Fields, by H. V. Ellis, (O.R.)

Two specimens of *Lepidodendron*, presented by Mr. Whittem, manager of the Wyken Colliery.

Specimen of *Terebratula numismalis*, from Hillmorton, presented by F. Willoughby.

The first authentic specimen of *Ammonites communis* from Rugby, presented by T. B. Oldham.

Some specimens of *Spondylus*, from New Bilton Lime Works, contributed by R. D. Oldham.

Several specimens of *Arca truncata* have been found in a beautiful state of preservation at Hillmorton, and have been presented to the Jermyn-street Museum.

Ichthyosaurus, from New Bilton.

The following is a report by Mr. Wilson on the ichthyosaurus found at New Bilton.

'In the Easter Vacation, 1874, the remains of an ichthyosaurus were found at New Bilton, about 17 feet from the surface, in the belt immediately below a band of stone filled with pentacrinite (see Plate vi. in the Report for 1872). It was partly in clay, partly in stone, and was accompanied with coprolites. I received a letter from Mr. Prance requesting me to examine and report on it, and I did so on April 24, with Dr. Oldham. It was lying in the offices of Mr. C. Hall, in many pieces, so imbedded in the matrix as to make the reconstruction of it a difficult work. It was presented by the owners of the works to Mr. Wilson and Dr. Oldham.'

Dr. Oldham undertook to commence the cleaning of it. To enable members of the Natural History Society to finish cleaning this specimen, and to clean others hereafter, he has presented the following tools:

30 chisels, 11 sizes.
21 points, 7 sizes.
8 files, of different sizes and makes.
4 hammers, all different sizes.
1 handle, with 5 small points of different sizes.

There has been considerable difficulty in cleaning this fossil, as it passed from one bed to another. The part in the clay was easily cleaned as the bone was hard and the clay soft, but in the limestone the bone was so soft that it would crumble away in the hand, and had to be soaked in glue to harden it.

Catalogue of German Collection of Rocks in the Arnold Library.

BY F. C. HOUGHTON, (M).

NOTE.—The numbers in the 4th column refer to pages in Cotta's "Rocks Classified and Described." Edition, 1866.

No.	*Name.*	*Locality.*	*Ref. to Cotta.*	*Description.*	
85	dolerite	near Aussig, Bohemia	136	crystals of labradorite (white), and augite (black), in matrix of both combined.	VOLCANIC.
87	dolerite	Grosspriessen, near Aussig	136	same as 85.	
89	anamesite	Bolvershahn, Siebengebirge	136	same composition as dolerite, but ingredients are barely visible.	
86	porphyritic dolerite	Fakum, near Aussig	136	crystals of augite with porphyritic do. of nepheline in matrix of combined labradorite and augite.	
84	nepheline dolerite	Löbau	136	crystalline compound of augite and nepheline with titaniferous magnetic iron ore.	
91	basalt	Geissingsberge, Altenberg	139	a compound of labradorite, augite, with magnetite.	
92	basalt	Spechthausen, Tharandt	139	slightly porphyritic with olivine, the larger masses are augite (?).	
100	basaltic lava	Kammerbuhl, Bohemia	141, *c*	crystals of olivine are visible.	
90	porphyritic basalt	Wohlbach, Adorf	141, *b*	porphyritic crystals of olivine in matrix of basalt.	
72	diabase	Ilkendorf, Nossen	147	compound of oligoclase, labradorite, anorthite and chlorite.	BASIC IGNEOUS.
64	gabbro (hypersthenite)	Volpersdorf, Murode, Schleswig	152, *d*	coarse-grained compound of labradorite and hypersthene.	
65	gabbro (diallage rocks)	Marbach, Rosswein	150	compound of diallage and labradorite with calcspar in the fissures.	
68	diorite	Halsbrücke, Freiberg	153	a compound of felspar and hornblende. The felspar is not orthoclase.	
70	diorite	Göda, Bautzen	153	ditto	
71	diorite	Freiberg	153	ditto	
69	porphyritic diorite	Stiebitz, Bautzen	155, *c*	with porphyritic crystals of felspar.	
73	aphanite	Zelle, Nossen	157	ditto	
74	slaty aphanite	Berggiesshübel	159, *c*	thick slaty cleavage.	

No.	*Name.*	*Locality.*	*Ref. to Cotta.*	*Description.*	
93	melaphyre	Plauen, Dresden	162	dark grey compact compound of felsite, hornblende, pyroxene, and magnetite.	PLUTONIC.
94	melaphyre	Ilmenau, Thuringia	164, *d*	dark grey compact: felsite, pyroxene, hornblende, magnetite. (*vide* Cotta).	
31	porphyrite	Wendisheim, Leissnig	168	amygdaloidal porphyry, mica and fragments in felsitic matrix.	
32	porphyrite	Wilsdruff	171, *B*	mica, hornblende, felspar, and fragments in dark red-brown felsitic matrix.	
57	hornblende porphyrite	Potschappel, Dresden	171	crystals of hornblende in compact felsitic matrix.	
56	mica porphyrite	Triebisenthall, Meissen	172, *C*	from veins penetrating syenitic granite, crystalline particles of mica and felspar in felsitic matrix.	
55	felsite porphyry	Zehren, Meissen			
16	minette	Seifersdorf, Dippoldiswalde	174, *A*	felsitic matrix with abundant mica, from veins in grey gneiss.	
12	syenite	Plauen, Dresden	177	two sorts, one having less felspar than the other.	
13	syenite (porphyritic)	Cöln, Meissen	178	porphyritic crystals of orthoclase in the usual crystalline matrix of syenite.	
99	trachyte	Drachenfels, Bonn	190, *B*	sanidine-oligoclase-trachyte. Crystalline compound of sanidine and oligoclase with magnesia, mica, and hornblende; large sanidine crystals porphyritically enclosed.	VOLCANIC.
97	trachyte	Stenzelberge, Siebengebirge	191, *C*	oligoclase-trachyte (domite). Oligoclase, mica, hornblende.	
96	trachyte	Wolkenburg, ditto		oligoclase-trachyte. Mica and oligoclase in felspathic matrix, with a little hornblende.	
88	trachydolerite	Löwenburg, ditto	192, *E*	the transition between dolerite and trachyte. (*vide* Cotta).	
80	perlite	Schemnitz, Hungary	184, *d* 196, *b*	sphærolitic perlite. Round felsitic grains in enamel-like matrix.	
95	phonolite (clinkstone)	Zittau	198	compact greenish matrix, enclosing crystals of a vitreous felspar.	
96	phonolite	Marienberge, Aussig	200, *C*	thinly scattered crystals of augite in greenish matrix of sanidine and nepheline (?)	
36	granite	Johanngeorgenstadt	203	shewing orthoclase (white) and oligoclase (red), with mica and a little hornblende.	PLUTONIC. ACIDIC IGNEOUS.
38	granite	Bobritzsch, Freiberg	203	quartz, orthoclase, oligoclase, mica, hornblende.	
39	granite	Nadelwitz, Bautzen	203	quartz, orthoclase (some distinct crystals), mica. (3 good hexagons).	
40	granite	Altenberg	203	orthoclase (pink), quartz, and mica.	
41	granite	Aue	203	quartz and felspar occurring in largish masses.	
37	porphyritic granite	Fichtelberge, Bavaria	205, *b*	porphyritic crystals of orthoclase and quartz in rather decomposed crystalline matrix.	
[illegible]	protogine	Hospice, St. Gothard	206, *g*	felspar (oligoclase), black mica, talc, quartz.	
43	syenitic granite	Zischewich, Meissen	207, *h*	orthoclase, oligoclase, silica hornblende, mica.	
44	syenitic granite	Reichenberg, Moritzburg	207, *h*	ditto	
58	granitic granite porphyry	Niederschona, Freiberg	213, *b*	quartz, mica, oligoclase (yellow), orthoclase (white). (*vide* Cotta).	
59	chloritic granite porphyry	Geissing, Altenberg	213, *d*	chlorite, orthoclase, and quartz.	
60	granite porphyry	Tannebergsthal, Auerbach	213	large quartz crystals and pink orthoclase in grey felsitic rock.	
49	quartz porphyry	Freiberg	215	crystals of quartz and orthoclase in felsitic matrix.	
51	quartz porphyry	Lochsteine, Altenberg	215	ditto	
52	quartz porphyry	Grillenburg, Freiburg	215	ditto	
54	quartz porphyry	Taucha, Leipsic	215	ditto	
53	quartz porphyry	Hilbersdorf, Freiberg	215	only a few crystals of quartz and orthoclase.	
50	quartz porphyry	Muldenthale, Nossen	218, *e*	ball porphyry (pyromeride). Contains balls of felsite marked with radial streaks.	
63	claystone porphyry	Mohorn, Freiberg	217, *a*, *γ*	nodules of quartz and foreign substances in compact felsitic matrix.	
77	pitchstone	Carsebach, Meissen	223	contains crystals of felspar.	
78	pitchstone	Planitz, Zwickau	225	contains balls of felsite, mica.	
79	porphyritic pitchstone	Spechthausen, Tharandt	225, *b*	porphyritic matrix with sanidine crystals.	

No.	*Name.*	*Locality.*	*Ref. to Cotta.*	*Description.*	
31	granulite	Hartmannsdorf, Chemnitz	229	compact compound of felspar and quartz.	Felspar Group. (Metamorphic Crystalline Schists.)
32	granulite	ditto ditto	231, *a*	laminated compound of felspar and quartz with a few garnets and little mica.	
33	granulite	Gersdorf, Rosswein	231, *a*	no mica, small garnets.	
34	granulite	Hartha, Waldheim	231, *a*	small quantity of mica, garnets, disthene.	
35	granulite with disthene	Rohrsdorf, Chemnitz	231, *a*	blue disthene (kyanite), and garnets.	
24	gneiss (grey)	Freiberg	238, *a*	compound of quartz, felspar, and mica.	
25	gneiss	Drehfeld, Nonen	238, *b*	porphyritic crystals of orthoclase.	
26	gneiss	Reifland, Lengefeld	238, *c*	coarsely fibrous, slightly porphyritic; mica, felspar.	
27	gneiss	Bieberstein, Freiberg	238, *d*	mica in parallel planes through the matrix.	
28	gneiss (red)	ditto ditto	234	contains more silica than previous varieties. (*vide* Cotta 234 et seq.)	
29	porphyritic gneiss	Erla, Schwarzenberg	238, *b*	egg-shaped crystals of orthoclase enclosed.	
8	mica schist	Lengefeld, Marienberg	241	mica and quartz, foliated texture, with garnets.	Quartz Group.
9	mica schist	Wittchensdorf, Chemnitz	241	very irregular in texture.	
10	wavy mica schist	Munzig, Meissen	243, *c*	mica and quartz (little of the latter), in fine foliated wavy texture.	
11	garnetiferous mica schist	Memmendorf, Oedran	243, *h*	mica and quartz with garnets imbedded.	
22	quartz schist	Freiberg	246, *a*	imperfectly foliated quartz with little mica.	
13	chlorite schist	Zöpptan, Mähren	250	chlorite schist with crystals of magnetite.	Chlorite, Talc, & Hornblende.
14	chlorite schist	Harthan, Chemnitz	250, *a*	(*vide* Cotta).	
15	talc schist	Zillerthal, Tyrol	251	principally talc, a little quartz, and a few particles of magnetite.	
83	erlan	Grünstädtel, Schwarzenberg		"intermediate between granulite and granatfels. sp. gr. 3.0—3.1 53.16 SiO_3 14.03 Al_2O_3, 7.14 Fe_2O_3, 14.4 CaO_1 5.42 MgO_1, like saussurite in appearance. Garnet, albite, and quartz."	
12	hornblende schist	Miltiz, Meissen	253, *a*	hornblende with small quantity of quartz and felspar.	
6	nodular schist	Wechselburg	257, *g*	(*vide* Cotta).	Argillaceous.
7	spotted schist	Tippersdorf, Oelsnitz	257, *g*		
5	clay slate	Lorsnitz, Schneeberg	263		Argillaceous. (Sedimentary and Fragmental.)
4	whetstone, honestone	Seifersdorf, Freiberg	265, *d*		
1	arenaceous clay slate	Lehsten, Saalfeld, Thuringia	265, *f*		
2	arenaceous clay slate	Plauen	265, *f*		
16	limestone	Fürstenberge, Schwarzenberg	277, *a*	granular crystalline.	Limestone.
17	limestone	Grottendorf, Scheibenberg	277, *a*	larger crystals than the former.	
18	cipollino	Zannhaus, Altenberg	277, *b*	limestone rich in mica, passing off at top into calcareous mica schist.	
19	dolomite (magnesian limestone)	Lengefeld, Marienberg	287	carbonates of lime and magnesia.	
66	schalstein	Dillenburg, Nassau	311, *A*	perfectly round grains of calcspar, with veins of the same in matrix of greenstone tufa.	Fragmental.
67	schalstein	Zelle, Nossen	311, *C*	clay slate containing grains of calcspar.	
75	serpentine	Waldheim	317	green in colour. Transmuted fr. granulite.	Serpentine Group.
76	serpentine	Zoblitz, Marienberg	317	crystalline.	

No.	Name.	Locality.	Ref. to Cotta.	Description.	
81	eklogite	Eppenreuth, Hof, Bavaria	318	garnets in matrix of smaragdite with mica.	GARNET GROUP.
82	garnet rock	Greifendorf, Heynichen	319	garnets in matrix of hornblende.	
47	greisen	Zinnwald, Altenberg	321	granular compound of quartz and mica. Associated with veins of tin ore.	GREISEN AND SCHORL GROUP.
48	zwitter rock	Altenberg	322	(*vide* Cotta).	
20	schoriaceous schist	Auersberge, Eibenstock	323, *a*	crystalline, laminated compound of schorl and quartz.	
21	topaz rock	Schneckensteine, Auerbach	306 324, *d*	crystals of topaz, quartz, and schorl rock on a breccia, laminated with augite and quartz.	
23	quartz	Freiberg	350, *b*		QUARTZ GROUP.
3	tydite (black chert)	Langenstriegis, Frankenberg	350, *e*	black chert with veins of quartz and fissures containing other substances.	

Collection of Minerals.

This note has been sent to me by Mr. Hutchinson.

'Mr. J. R. Stuart Russell has presented a collection of about 100 minerals to the School.

'The greater part I have named and placed with the collection in the Arnold Library.

'The specimens comprise various ores of lead, zinc, iron, copper, and tin. Some good quartz crystals, calcite, fluor spar, various silicates including Heulandite, Stilbite, Epidote, Actinolite, Mica, Asbestos (very fine), lava from Pompeii, &c. &c.

'Some of the smaller and commoner specimens will come in very useful for supplying substances for analysis to the more advanced pupils in the Laboratory. Such contributions will at all times be gratefully received.

'*December*, 1874. —— T. N. HUTCHINSON.'

Note on a Well sunk at Clifton Vicarage.

An extract from a letter from Mr. Newall to Mr. Wilson.

'So far as I can recollect, the contractor, Mr. Rathbone of Hillmorton, dug 80 ft. and bored about 60 more, total 140 feet. After thin strata of sand and gravel, he came upon blue clay mixed with chalk stones of various sizes and in profusion till water was discovered.'

Two Sections of Wells.

Two sections have been contributed by E. W. Hopewell, from Newbold, and are valuable as shewing the rocks lying under a district in which the underlying rocks were not known before. The first is beside the clay pits and has a pump attached. The locality is the field opposite the entrance to Mr. Walker's house below the old canal.

Surface soil, 1ft.
Yellow clay, 1ft.
Blue clay, 6ft.
Soft brown rock, 6 in.
Blue clay, 6ft. 6in.
Blue limestone rock, 8in.
Hard blue shaly clay, 3ft. 6in.
Hard blue rock, 8in.
Hard blue shaly clay, 4ft.
Hard blue rock, 1ft. 2in.
Hard blue shaly clay, 1ft. 3in.
Hard blue rock, 6in.
Hard blue shaly clay, 1ft. 6in.
Hard blue rock, 7in.
Hard blue shaly clay, 2ft. 6in.
Hard blue rock, 9in.
Hard blue shaly clay, 2ft. 3in.
Hard blue rock, 9in.
Hard blue shaly clay, 3ft. 6in.
Hard blue rock, 7in.
Total depth, 40ft. 2in.

The second well is by the cottages that are being built, and is about 100 yards s.w. of the first, and about 6 feet 6 inches below. It is as follows:

Surface soil, 1ft.
Brick clay, 8ft.
Best blue lias rock, for cement, 11in.
Clay, 2ft. 6in.
Blue lias rock, 1ft.
Clay, 2ft. 6in.
Blue lias rock, 9in.
Clay, 1ft. 6in.
Blue lias rock, 10in.
Shaly clay, 2ft. 6in.
Blue lias rock, 8in.
Shaly clay, 2ft. 6in.
Blue lias rock, 8in.
Shaly clay, 5in.
Blue lias rock, 6in.
Shaly clay, 6in.
Blue lias rock, 6in.
Shaly clay, 6in.
Blue lias rock, 9in.
Total depth, 28ft. 6in.

Boring at Lodge Farm.

The following is a note by Mr. Wilson.

'A boring was made in January, 1874, at a place called Lodge Farm, about half a mile due east of Clifton, south of the road to Lilbourne. The section was as follows:

Yellow clay, 2ft.
Blue lias clay, 26ft.
"Sludge," 2ft.
Blue lias clay, 30ft.
Shaly rock, 1ft.
Blue lias clay, 40ft.

'At this point I was asked for advice as to continuing the boring, or getting water in some other way. My advice was to stop, and tap the gravel bed to the north and west, sink a shallow well, and pump the water there, and let it run by a pipe to the farm house. The gravel is entirely wanting on the slope of the hill that faces south-east between Clifton and Lilbourne, but lies on the top and northern sides, though irregularly.

'It may be noticed that from the stratum called "sludge" came a steady flow of water strongly impregnated with sulphuretted hydrogen.

'*January*, 24, 1874. J. M. WILSON.'

Note on the Labyrinthodon.

'The specimen I exhibit this evening is the impression of the head, vertebrae, and ribs, of a small Labyrinthodon on a piece of coal. It was given me by J. R. Allen (O.R.), and I have submitted it to Mr. Etheridge and Professor Huxley for examination. The former pronounces it to be different from any of the Labyrinthodonta at present described; the latter would not undertake to pronounce upon it. It is at any rate a very rare and perhaps unique specimen. I have mounted it in plaster of Paris for its better preservation, and made a sketch of it, which has been copied by C. Kerr, and appears on Plate 1.

'These Labyrinthodonta are a very interesting class of reptiles. They range from the Coal-measures, and the specimen before us is from the base of the Irish Coal-measures, through the Permian and Triassic into the Lias formation, affording a fine example of a persistent type, and one that bridges over the great interval between the Permian and Lias.

'J. M. WILSON.'

A Section exposed on the Lawford Road.

Plate 7 is a sketch of a section exposed on the slope of the hill on the Lawford Road, just above the entrance to the New Bilton Par-

sonage. It illustrates well the relations of the red sands and the unquestionable glacial clays, the so-called northern drift. It is conclusive on the contemporaneity of the red sands and glacial clays. The red sands come to the surface a hundred yards down the hill, and then thins out before the brickworks and the railway.

The Geological Model of Rugby.

The object of the geological model of Rugby is to give an idea of the configuration of the neighbouring country far better than any amount of description.

This configuration depends much on the river valleys, and the model will be a great help in determining the origin of the river valleys, and in pointing out how much their present shape is due to subaerial or marine causes. Another use of it will be to form a basis on which to put all previous records of the drifts, and on which information which will be collected in the future can be put down in a form much more accessible than detached papers scattered through the Natural History Society Reports.

After it had been determined that a model of the country round Rugby should be made, there still remained several questions to be answered.

I. The limits of the region to be modelled.
II. What vertical and horizontal scales should be used?
III. What should the modelling material be?
IV. What should the final model be made of?

First, as to the region to be modelled. This must not be so large that any parts should be out of reach of an afternoon's walk, but, on the other hand, it must be as large as we could manage: and so it was finally determined that the size should be 8 miles square. It would be advantageous however if the model could be carried as far as the watershed on the E, *i.e.* 4 miles further.

Secondly, as to the scale. In some models the vertical scale is exaggerated with regard to the horizontal scale in the proportion of 2 to 1; some in flat regions as much as 6 to 1, *i.e.* the hills are 6 times as high as they ought to be on a true scale, and the slopes are 6 times as steep as in nature. The proportion in which the vertical scale should be exaggerated depends on the difference between the extreme altitudes in the district. We determined that the horizontal scale should be 6 inches to the mile, and found that 120 feet to the inch was the best vertical scale to correspond, *i.e.* the vertical scale was exaggerated as 7½ to 1. This scale will make the model 4 feet square, or 6 feet by 4 feet if it be extended eastwards.

Thirdly, as to the mode of modelling. The most usual manner is to draw the contours every 10, 25, or 50 feet, according to the nature of the country, then to cut them out in cardboard of a thickness representing the height between the contours, and paste the cardboard contours on one another. A second plan is to place the map on the bottom of a box the size of the model, and putting pins in at different places cut off so that their tops shall be at the altitude of those places, and then putting in the clay and modelling down to them.

The first of these ways was in our case impracticable, as we could not get the contours with sufficient accuracy, and so it was determined that volunteers should each take a square mile and model it by himself in a separate box. This was however found impracticable, and so it was determined to make the model in a large box 4 feet by 2, which would hold half the model.

For maps we had the ordnance survey maps, and each volunteer enlarged his square from them to a scale of 6 inches to the mile. Then for starting points we had the bench marks of the ordnance survey, from which we could get the altitudes correctly enough by aneroid barometers, and to guard against errors several observations were taken on different days, so as to check each other. We had also railway sections to help us.

After the altitudes had been got, the next thing was to make the model in clay. This clay is specially prepared for modelling, and is cleaned and prepared by D. Brucciani, Russell Street, Covent Garden, from whom it was procured. Then, instead of taking the bottom at a fixed level and working up from it, we took the top of the box as representing an altitude of 400 feet above the level of the sea. This necessitated our making special rules by which we could measure off the altitude from a string stretched across the box, which gave us a down line from which to set off the altitudes.

There is one obvious point of importance in modelling that escaped, however, some of us; and that is, that if a place is too high the superabundance must be taken off by removal and not by pressure; for if it be simply pressed down it will only cause other parts to rise. We put in all canals, quarries, embankments, &c., and sections will be painted on the sides. For tools we had only a scraper or two, and found them quite enough. Fingers are the best tools.

Fourthly, as to the substance of which the final model was to be made. Paraffin shrinks too much, and we came to the conclusion that the only substance available was plaster of paris, of which 2 cwt. were used. First the plaster is mixed and poured into the clay, and left for two hours to set and then taken off. After this mould was well rubbed with boiled linseed oil, and then the cast was made, into which two longitudinal and lateral pieces of iron were let. The cast when taken off was slightly imperfect, as some of the canals and embankments had been broken, but they were easily repaired, and now one-half of the model is finished and only wants colouring.

The following is a list of those who took part in the work.

Hon. Members.

G. M. Seabroke
J. M. Wilson

Members.

E. T. Wise
B. R. Wise
H. N. Hutchinson
H. Vicars
W. Larden
R. D. Oldham

Associates.

J. Y. Bostock
G. Varley
H. L. Baggallay
E. J. Power
H. F. Wilson

I have entered into some detail in this report on the model, in the hope that it may be of value to some other local societies.

R. D. OLDHAM.

Zoological Section.

Observations at Rugby during 1874.

Mar. 16	Starling's nest began	B. R. Wise
Mar. 20	Thrush began to lay	B. R. Wise
April 4	Carrion Crow, (with eggs)	R. Cunliffe
April 15	Robin, (4 eggs)	R. Cunliffe
April 20	Swallows seen	H. Vicars
April 22	Martins seen	H. Vicars
April 22	Cuckoo heard	H. Vicars
April 23	Water Wagtail, (eggs hard set)	H. Vicars
May 3	Moorhen, (1 egg)	R. Cunliffe
May 3	Stone Chat, (4 eggs)	R. Cunliffe
May 3	Tree Sparrow, (4 eggs)	R. Cunliffe
May 10	Magpie, (4 eggs)	R. Cunliffe
May 19	Tree Creeper, (with young)	R. Cunliffe
May 23	Yellow (Rays) Wagtail, found near Bilton	W. B. Thornhill
May 24	Meadow Pipit, (with eggs)	W. B. Thornhill
May 31	Reed Warbler, (2 eggs)	R. Cunliffe
June 2	Swallow, (3 eggs)	R. Cunliffe

A Wheatear's nest was found in a *blackthorn hedge four feet from the ground.* (B.R.W.)

The average of several calculations gives the number of Rooks' nests in the Close as 99.

The drawers of the egg-cabinet have been divided so as to leave a partition for every known British egg. Each partition will be labelled with the name of the bird for which it is intended. A red R after the name will denote that that specimen was found in Rugby. Any contributions of eggs will be thankfully received.

W. Larden (O.R.) has contributed interesting notes on various birds, but which we have not room to print. He especially notices the fact that the Night-jar, when disturbed by the approach of any one, if it is in front of the intruder invariably crouches on the ground, in the hope of escaping notice; if however it is pursued it either flies up a little further *ahead* and again crouches, or hovers in the air *behind*, but only crouches on the ground when in front of one.

He also notices that Cuckoos have two other cries besides the usual cuckoo, viz. a Blackbird-like hick-hick-hick, which from his observations he thinks to be caused by alarm, and the other a hissing noise like that of an angry cat. (See paper by W. Larden, last meeting.)

B. R. WISE.

Entomological Section.

The Entomological Section have not been able to do much this year in extending the list of local captures, or in making observations on the time of appearances of the known insects which frequent the neighbourhood. Their work has been chiefly confined to the arrangement of the cabinet of Lepidoptera, in which considerable progress has been made. Spaces have now been provided for all butterflies and moths as far as the Tineae; and even of this last section of the moths a good deal has been done. Out of the whole 30 drawers 27 have been duly fitted with labels and lines and camphor to receive the moths when they are caught. The Section hope to complete this work soon, and then the cabinet will only require periodical attention to see that the new specimens are duly

inserted, that new camphor is supplied as soon as the old stock is evaporated, and that parasites are carefully watched, and the insects affected with them promptly dealt with.

Another point that has been attended to this year is the local insects in the collection. The collection is for the whole of Great Britain: and the original idea was to put local insects in separate cases. But it was found that the cases, from constant pulling down and careless opening and shutting, suffered so much that the local collection bade fair to be a collection of headless and wingless cripples. The authorities therefore decided to form a coalition: to put the Rugby specimens in the cabinet, and distinguish those species which had been found in our district by a red R, placed next the specific name. Thus the insects are safer, and yet the local species are recognisable at a glance.

This being the report of work done, it remains to say a few words about the deficiencies in the work of this Section, in the hope of securing more aid in future; and to draw a slight sketch of what we might do, and ought to attempt to do, if the entomologists shew a proper amount of energy and public spirit.

First then, notices of early and late appearances. This part of the subject is very important, as enabling us in time to obtain reliable information as to average time and duration of an insect's appearance, and also as marking in each year the variations from the average, the undue earliness or lateness. It would be a valuable supplement to the botanist's register; and we should be able to discover how far the same causes (wet, dry, cold, heat, &c.) affected plants and insects in a similar manner. Also *any body* can contribute to this, who knows a moth or butterfly when he sees it: and *all* observations are valuable. The commoner the insect, the greater the certainty that could be arrived at respecting its time of appearance.

Secondly, in our local list there occur many names which rest on no more recent authority than that careful and energetic collector, Mr. G. B. Longstaff. Now it is quite possible that these names may contain some errors: it is quite possible that some species may have become extinct. In any case, more recent guarantees of these insects having been observed would be valuable. It is melancholy to compare the cabinet with the local list. One might expect to find specimens of all the species mentioned in the local list appearing in the cabinet. But there must be between 50 and 100 names in the list which in the cabinet show—a conspicuous blank.

Again, this Section is seriously hindered by the unfortunate fact—unfortunate in this respect—that we are away for August and September. Those two precious months are lost, to the mass of us, for purposes of local observations. All the more earnestly then do we appeal to those who live here, to help us to fill up the gaps in our information about those holiday months.

Fourthly, the Society is sadly in want of some one to undertake other branches besides Lepidoptera. Beetles, Hymenoptera, Dragonflies, Bugs proper, are all we believe interesting studies, if only one sets to work at them. Even spiders have great qualities, hidden beneath that unattractive exterior. The first step in this direction has been taken this year by a study on bees, which appears above, p. 32.

The Museum and statistical work that remains to do is as follows.

(1) To complete the naming of the cabinet drawers, ready to receive the moths of the future. This we hope to do soon.

(2) To put together a clear and complete account of our collection, with full explanations of the cabalistic initials which appear there, mention of our chief benefactors, and short biographies of our principal varieties in the way of moths. This perhaps the existing Section could do for next year's Report.

(3) To get a list marked, with all our possessions and desiderata, so that anyone inspecting the collection can find what we have by reference to the list, without the trouble of opening 20 wrong drawers first.

(4) To arrange our duplicates, and organize a system of exchange, and perhaps occasional distribution: with an eye to mutual advantage.

(5) To stimulate the spirit of generosity in the human breast, so that as many people as possible may present us as rare moths as possible, as often as possible.

To sum up briefly: we want observations, corrections, workers in summer holidays, workers in other branches; the names of all who will join the Section and do arranging and statistical work; and finally, donations of specimens.

List of Lepidoptera.

(Observed within eight miles of the School Close.)

A. S.	A. Sidgwick, 1853—1875.
G. B. L.	G. B. Longstaff, 1866—1867.
A. F. B.	A. F. Buxton, 1870—1871.
J. S. M.	J. S. Masterman.
H. V.	H. Vicars, 1866—1875.
A. H. W.	Rev. A. H. Wratislaw, Bury.

Papilionidae
Gonepteryx Rhamni
Colias Edusa (A. S.)
Pieris Brassicae
" Rapae
" Napi
Anthocharis Cardamines
Leucophasia Sinapis (H. V.)

Nymphalidae
Lasiommata Aegeria
" Megaera
Hipparchia Tithonus
" Hyperanthus
" Janira
Caenonympha Pamphilus

Vanessidae
Cynthia Cardui
Vanessa Atalanta
" Io
" Antiopa (H. V.)
" Polychloros
" Urticae
Grapta C-Album

Argynnidae
Argynnis Paphia
" Adippe
" Aglaia
" Selene
" Euphrosyne

Lycaenidae
Thecla Quercus
Chrysophanus Phlaeas
Polyommatus Alexis
" Argiolus (A.H.W.)

Hesperidae
Thymele Alveolus
Thanaos Tages
Pamphila Linea
" Silvanus

SPHINGINA.

Zygaenidae
Anthrocera Lonicerae (A.H.W)
" Filipendulae
Procris Statices (G. B. L.)

Sphingidae
Smerinthus Ocellatus
" Populi
" Tiliae
Acherontia Atropos
Sphinx Ligustri
Chaerocampa Elpenor
" Porcellus

Sesiidae
Macroglossa Stellatarum
Sesia Fuciformis

Aegeriidae
Trochilium Tipuliforme

BOMBYCINA.

Hepialidae
Hepialus Hectus
" Lupulinus
" Sylvinus
" Humuli

Zeuzeridae
Zeuzera Aesculi
Cossus Ligniperda

Notodontidae
Cerura Vinula
" Furcula (A. S.)
Pterostoma Palpina
Notodonta Dictaea (A. S.)
Lophopteryx Camelina
Diloba Caeruleocephala
Pygaera Bucephala

Liparidae
Psilura Monacha (H. V.)
Dasychira Fascelina (?)
" Pudibunda
Orgyia Antiqua
Stilpnotia Salicis
Porthesia Chrysorrhaea (?)
" Auriflua

Lithosidae
Miltochrista Miniata (A. S.)
Lithosia Complanula
Nudaria Mundana (A. S.)

Chelonidae
Arctia Caja
Spilosoma Menthastri
" Lubricipeda
Callimorpha Jacobaeae (H. V.)

Bombycidae
Lasiocampa Quercus
Eriogaster Lanestris (A. S.)
Trichiura Crataegi (A. S.)
Clisiocampa Neustria
Odonestis Potatoria

Platypterygidae
Cilix Spinula

NOCTUINA.

Noctuo-Bombycidae
Thyatira Derasa (A. S.)
" Batis (A. S.)

Bryophilidae
Bryophila Perla

Bombycoidae
Acronycta Tridens
" Psi
" Aceris
" Megacephala
" Alni (A. S.)
" Rumicis

Leucanidae
Leucania Impura
" Pallens

Apamidae
Gortyna Flavago (A. S.) ?
Axylia Putris
Xylophasia Lithoxylea
" Polyodon
Luperina Testacea
Mamestra Brassicae
" Persicariae
Apamea Basilinea (A. S.)
" Oculea
Miana Strigilis
" Fasciuncula
" Arcuosa (G. B. L.)

Caradrinidae
Grammesia Trilinea (A. S.)

Noctuidae
Agrotis Suffusa
" Segetum
" Exclamationis
Triphaena Ianthina
" Interjecta
" Orbona
" Pronuba
Noctua Plecta
" Xanthographa

Orthosidae
Taeniocampa Gothica
" Instabilis
" Stabilis
" Munda
" Cruda
Orthosia Upsilon
" Lota
" Macilenta
Anchochelis Pistacina
" Litura

Orthosidae (continued)
Cerastis Vaccinii
" Spadicea
Xanthia Ferruginea
Cosmia Diffinis

Hadenidae
Polia Chi
" Flavicincta
Miselia Oxyacanthae
Agriopis Aprilina
Phlogophora Meticulosa
Euplexia Lucipara (A. S.)
Hadena Protea
" Glauca

Calocampidae
Calocampa Exoleta
Cucullia Verbasci
" Umbratica (A. S.)

Heliothidae
Heliodes Arbuti

Phalaenoidae
Brephos Notha (A. H. W.)

Plusiidae
Plusia Chrysitis
" Festucae (?)
" Iota
" Gamma

Gonopteridae
Gonoptera Libatrix

Amphipyridae
Mania Typica
" Maura

Catocalidae
Catocala Nupta

Euclididae
. Euclidia Mi
" Glyphica

GEOMETRAE

Urapteridae
Urapteryx Sambucaria

Ennomidae
Rumia Crataegaria
Eurymene Dolobraria (A. S.)
Pericallia Syringaria (G. B. L.)
Selenia Illunaria
" Lunaria
" Illustraria (A. S.)
Odontopera Bidentaria
Crocallis Elinguaria
Ennomos Angularia

Amphidasydae
Phigalia Pilosaria (A. S.)
Biston Hirtaria (A. S.)
Amphidasys Prodromaria
" Betularia

Boarmidae
Hemerophila Abruptaria
Boarmia Repandaria
" Rhomboidaria
" Abietaria (G. B. L.)
Tephrosia Crepuscularia (A.S.)

Geometridae
Pseudoterpna Cytisaria (?)
Iodes Lactearia (G. B. L.)
Hemithea Thymiaria (A. F. B.)

Ephyridae
Ephyra Punctaria

Acidalidae
Asthena Luteata (G. B. L.)
" Candidata
" Sylvata (G. B. L)
Acidalia Scutulata (G. B. L.)
" Bisetata (G. B. L.)
" Incanaria (G. B. L.)
" Remulata
" Imitaria
" Aversata
" Emarginata (G. B. L.)
Bradyepetes Amataria

Caberidae
Cabera Pusaria
" Exanthemaria

Macaridae
Macaria Liturata (A. S.)
Halia Vauaria

Fidonidae
Strenia Clathraria (G. B. L.)
Fidonia Piniaria (G. B. L.)

Zerenidae
Abraxas Grossulariata
Lomaspilis Marginata

Hibernidae
Hibernia Rupicapraria(G.B.L.)
" Progemmaria
" Defoliaria (G. B. L.)
Anisopteryx Aescularia

Larentidae
Cheimatobia Brumata
" Boreata (?)
Oporabia Dilutata
Larentia Didymata
" Miaria

Larentidae (continued)
Emmelesia Alchemillata
" Albulata
" Decolorata (G.B.L.)
Eupithecia Castigata } G. B. L.
" Exiguata
" Vulgata
" Lariciata
Hypsipetes Elutata
Melanthia Ocellata
" Albicillata
Melanippe Subtristata
" Montanata
" Fluctuata
Antidea Rubidata
" Badiata (A. F. B.)
" Derivata (H. V.)
Coremia Unidentaria
" Ferrugaria
Camptogramma Bilineata
Scotosia Dubitata } (G. B. L.)
" Certata
" Vetulata
" Undulata (A. F. B.)
Cidaria Miata
" Corylata
" Russata (G. B. L.)
" Suffumata (G. B. L.)
" Silaceata (A. S.)
" Populata (A. F. B.)
" Fulvata
" Pyraliata
" Dotata (H. V.)

Eubolidae
Eubolia Mensuraria
Anaitis Plagiata (G. B. L.)
Chesias Spartiata (J. S. M.)

Sionidae
Odezia Chaerophyllata (A.F.B.

PYRALES.

Hypendae
Hypena Proboscidalis

Herminidae
Herminia Tarsipennalis (G.B.L.)
Rivula Sericealis (A. S.)

Pyralidae
Pyralis Farinalis

Ennychidae
Pyrausta Purpuralis (G. B. L.)
Herbula Cespitalis (G. B. L.)

Hydrocampidae
Cataclysta Lemnalis
Paraponyx Stratiotalis
Hydrocampa Nymphaealis

Botydae
Botys Urticalis
Ebulea Sambucalis
Pionea Forficalis
Scopula Lutealis
" Olivalis
" Prunalis

Choreutidae
Simaethis Fabriciana

CRAMBITES.

Eudoreidae
Eudorea Ambigualis

Crambidae
Crambus Pratellus
" Pascuellus (G. B. L.)
" Periellus (G. B. L.)
" Culmellus
" Hortuellus

TORTRICES.

The Tortricina are so confused in nomenclature, and have been lately so little studied in the district, that it seems scarcely worth while to issue a list at present.

The following donations have been added to the collection this year:

Dianthaecia Irregularis.
Acidalia Rubricata.
Agrophila Sulphuralis (3)
Iodis Vernaria.
Lithostege Nivearia (3)

All these valuable insects are quite new to the collection, and were given by the Rev. A. H. Wratislaw; the first-named having been discovered by him.

A. SIDGWICK.
H. VICARS.

Record of appearances.

Name.	First seen.	Last seen.
Taeniocampa Stabilis	27 Feb.	14 April
" Instabilis	10 March	14 April
Vanessa Polychloros	20 April	
Callimorpha Jacobaeae	2 June	
Euplexia Lucipara	11 June	

It was a fair season for most common specimens. During June and July the common Yellow Underwing (Triphaena Pronuba) was extraordinarily abundant. All outhouses, sheds, ivy, palings, bushes, cornices, old walls, &c., were full of them: some were found in a Master's drawer in one of the schools; and we have even heard from one gentleman who found them in his bed! A.S., H.V.

Botanical Section.

In our last issue we expressed our intention of printing a separate report of the Section with a complete list of flowers. This, however, circumstances prevented us from doing. We now make a few observations on the work of the Section during the last two years.

1873.

Notices of 190 flowering plants were recorded this year; this list is indeed very deficient, chiefly owing, we think, to the great want of real workers in the Section.

On May 19th we made an expedition to Princethorpe and Frankton. [See p. 14 of last year's Report.]

The following plants have been added to the list, or are to be removed from brackets.

Reseda luteola. New locality, near Lawford Hall; H. W. T., Rev. A. B. Formerly recorded from Harboro' Magna by Rev. A. B.

Barbarea intermedia. }
Barbarea praecox. } May, 1873. F. E. K.

Viola hirta. New locality, between Newbold Mill and rail on the way to Rugby. F. E. K.

Ononis arvensis. Roadside near Princethorpe (new locality); H.W.T.

Carex (strigosa). Princethorpe Wood. F. E. K.

Carex vesicaria. To be removed from brackets, as growing in a pond by Blue Boar Lane. Rev. A. B., H. W. T. Formerly found at Frankton by H. G. W.

Also, we have a list of flowers from Rev. A. Bloxam.

Rosa caesia. Several localities, Harboro'.

Rosa decipiens. Harboro'.

Galeopsis angustifolia (= *ladanum*). Cornfields, by Harboro'.

Orobanche (*minor*). Roadside between Brinklow and Coombe.

Bupleurum (rotundifolium). Brinklow station, on the down side embankment.

Spergularia rubra. Cemetery walk.

Cuscuta trifolii. Clover fields of Mr. Norman and Mr. Meddows, in 1871.

Reseda suffruticulosa. Several specimens in a potato plot in Easenhall, near Harboro' Magna.

Cardamine impatiens. Rubbish heap in Harboro'.
Salix stipularis. }
„ *Russelliana.* } Montelo Lane, near Harboro'.
„ *viminalis.* }
„ *fragilis.* Near Newnham Bath.
„ *Helix.* Side of pond on the glebe farm.

The following members and associates assisted Mr. Kitchener this year in the observations.

G. L. King	H. W. Trott	R. A. Fayrer
E. T. Wise	V. H. Veley	R. D. Oldham

1874.

We regret that we are again unable to lay before the Society a list of the Rugby plants. We had prepared for publishing a complete list, with the dates of the years 1871—1874, and the average date of each flower from the year 1867—1874. But we have lately found that a new edition of the London Catalogue has been brought out, and it will need a considerable amount of time to bring our list to agree with it. Our list, as it is, would be of comparatively little use to botanists, because the London Catalogue has been so much altered.

We shall, if possible, bring out a revised list of plants after the summer holidays. It will be by far the most complete list of Rugby plants that has ever been published, and will contain a list of Rugby Rubi, Rosae, and Salices, named by Rev. A. Bloxam, whom we take this opportunity of thanking most heartily for all the assistance he has given us in this Section of our Society.

We can therefore do nothing here but publish our notes on the work of the Section.

We have received notices of the date of flowering of 280 plants, a small proportion of our list as compared with the years 1869, 1870, 1871. In those years the number of plants observed was respectively 325, 242, 350. Of the 280 of this year, the majority are from two collectors, and those chiefly from one district; the dates are therefore not very reliable, and the more so, because so many of the flowers were not observed at all till they had been in bloom for some days, and in many cases were withering or even in seed.

The Monocotyledons (sedges, grasses, &c.) have as usual received but a very small share of notice.

We have no new flowers to record, and only a few new localities.

Teesdalia nudicaulis. Lost in 1873. Recovered this year in its former locality, Lower Hillmorton Road, on April 3. There were not more than 6 roots this year. It seems to have been choked by the grass. H. W. T.

Lamium incisum. New locality, the allotments by the footpath to Long Lawford. H. W. T.

Cichorium Intybus. Grows abundantly on roadside between Newbold and Harboro'; also a few specimens in Lawford Fields, by the Lime Works. H. W. T.

Carduus Eriophorus. About a dozen roots of this grow in Cathiron Lane, by the old canal. Rev. A. B.

Carduus acaulis. New locality, banks of waste lime in Lawford Fields. H. W. T.

Carduus Marianus. Believed to have been eradicated from its old locality, "Leicester Arches"; lost since 1870. Six roots observed there this year. H. W. T.

Bidens tripartita. New locality, canal bank, by Barby Road; also in a pond this side of the canal. F. E. K.

Linaria minor. Formerly found on a rockery in Mr. Vecqueray's garden, and reported (probably incorrectly) as L. Pelisseriana, which only grows in the Channel Islands. Found in June this year in a cornfield towards Newbold beside the footpath. H. W. T.

Borago officinalis. Grows apparently wild in a lane near Harboro'; may possibly have escaped from a vegetable garden at a short distance from it. H. W. T.

Asplenium Adiantum-nigrum. New locality, in a ditch on the south side of the Avenue Road, about ¾ mile from the Blue Boar; also on an old wall near Little Lawford mill. H. W. T.

Blechnum boreale. New locality, lane near Wolston Heath. H.W.T. Formerly found by H. G. W. in a copse near the Blue Boar.

A list has been made of the plants still out on November 1. We find that 75 out of our list of about 550 were either in bud or in bloom on that day. The most remarkable of these are the Dog Rose, Meadow Sweet, Honeysuckle, and Germander Speedwell. This list compares favourably with those of two former years, 1870, 1872, which were respectively 30 and 39, but unfavourably with that of 1871, which was 95.

List of Flowers observed on November 1.

Ranunculus acris
„ repens
„ sceleratus
Papaver Argemone
„ Rhœas
Fumaria officinalis
Capsella Bursa-pastoris
Sisymbrium officinale
Viola arvensis
Lychnis vespertina
Sagina procumbens
Spergula arvensis
Stellaria media
„ graminea
Cerastium aquaticum
„ glomeratum
Malva sylvestris
Geranium molle
„ Robertianum
Ulex Europæus
Melilotus officinalis
Trifolium repens
„ pratense
„ minus
Medicago lupulina
Spiræa Ulmaria
Geum urbanum
Rubus fruticosus
Hedera Helix
Æthusa Cynapium
Sium angustifolium
Heracleum sphondylium
Anthriscus sylvestris
Lonicera Periclymenum
Galium Aparine
Tragopogon pratense
Hypochæris radicata
Sonchus oleraceus
Crepis virens
Taraxacum officinale
Lapsana communis
Rosa canina (Nov. 15)
Centaurea nigra
Carduus nutans
„ lanceolatus
„ marianus (bud)
„ arvensis
Senecio vulgaris
„ Jacobæa
Bellis perennis
Chrysanthemum segetum
„ Leucanthemum
„ Chamomilla
Achillea millefolium
Campanula rotundifolia
Veronica Chamædrys
„ Buxbaumii
Lamium album
„ purpureum
„ incisum
Galeopsis Tetrahit
Stachys sylvatica
Myosotis arvensis
Anagallis arvensis

Plantago major	Urtica urens
Chenopodium album	„ dioica
Polygonum Persicaria	Poa annua
Euphorbia Helioscopia	Polypodium vulgare
„ exigua	Lastrea Filix-mas
„ Peplus	

We have now mounted about $\frac{4}{5}$ of the local collection in books, and hope to have the whole completed and labelled by the end of the year. This has been a work of much time and labour, but in the present form the collection is more available for reference than in the former one.

Those who have assisted Mr. Kitchener in recording dates, &c., this year are

E. T. Wise	H. W. Trott	V. H. Veley
R. A. Fayrer	R. D. Oldham	

Lastly, we cannot too urgently beg for assistance in this Section of the Society during the present year, especially as there is now so great a probability that Botany will become but a mere name at Rugby.

F. E. KITCHENER.
H. W. TROTT.

STATISTICAL AND OTHER PAPERS.

Under this head are printed various lists and papers which it is desirable that the Society should possess in a form at once permanent and accessible.

Science Commission.

Report on the Rugby School Museum, sent to the Royal Commission on Scientific Instruction and the Advancement of Science.

[FOR SCHOOL REPORT.]

RUGBY SCHOOL MUSEUM.

History.—The origin of the museum was a collection of common stones from various parts of England brought to the school by the boys at Dr. Arnold's request. These were placed in cases, in many instances without names, or localities, or arrangement. Subsequently, two of the assistant masters, the Reverend C. T. Arnold, and the Reverend H. Highton, arranged and catalogued such of these as could be identified, and added to the collection some specimens of rocks and fossils obtained by purchase.

Rooms.—The rooms at present available for collections to illustrate Natural History are a part of the Arnold Library, and a small room belonging to the Natural History Society.

Geological Museum.—In the Arnold Library are placed the geological collections. These consist of (1) a *local collection* of *Lias fossils* and *Drift stones*, which has gradually accumulated under its present curator, Mr. Wilson, partly from the gifts of collections made by the boys. A list of this collection has been published in the R. S. N. H. Society's Reports.

There is also (2) a *general collection of fossils* arranged stratigraphically in a series of glass cases, with drawers underneath, which is sufficiently complete as regards characteristic fossils, for elementary geological teaching. It contains, however, but few *fine* specimens, being the result not of purchase but of amateur work in various parts of England. Among donors to this collection, besides the present curator, may be named Mr. J. R. Allen, Reverend T. G. Bonney, Mr. W. H. Dutton, Mr. S. G. Perceval, Reverend T. A. Preston, Reverend C. S. Taylor, Mr. G. H. West.

There is (3) *a collection of rocks* formed by the present curator, partly by purchase. This has been lately arranged by Mr. F. C. Houghton, in a series of shelves behind glass, according to the arrangement of Cotta. This collection is also fairly adequate for elementary teaching of Geology.

Lastly, (4) there is a *collection of minerals and ores*, made from various sources, which has been arranged by the Reverend T. N.

Hutchinson, for the most part on a chemical basis. The collection though very incomplete must be regarded as adequate to its present use in teaching.

A collection of photographs, sketches, and diagrams has been made by Mr. Wilson, and is found of the greatest use in geological teaching. Some microphotographs have been presented by Reverend H. H. Higgin.

A model of the neighbourhood, on a scale of 6 inches to the mile, is in process of formation.

Botany.—In Botany the school possesses a herbarium of British plants, collected by Mr. Kitchener. There is also a special local collection of plants. It being found that a herbarium in its usual form is of hardly any use to a school, as only a few boys can be trusted to have admission to it freely for reference, the local collection is in course of transference into large note books, where they will be securely fastened, and replaced from time to time if injured.

Various collections have been also presented. British ferns by Mrs. Gray; Canadian and other plants by Mr. Moberly; British plants by Mrs. Phillpotts (many plants in this collection were collected and named by the late Miss Warren). British Rubi and Salices by Reverend A. Bloxam; New Zealand plants by Mr. Reid of Otago. The school also possesses the series of drawings and specimens illustrative of the natural orders prepared by Mr. Oliver of Kew, and a considerable number of other diagrams on botany.

Zoology.—In Zoology we have a valuable series of *dissections* illustrating the comparative anatomy of the animal kingdom, and specially adapted to Dr. Rolleston's "Forms of Animal Life." The preparations were arranged by Mr. C. Robertson, Demonstrator of Anatomy in the Oxford Museum, and are duplicates of the original Oxford series. They were presented by Mr. G. H. Morrell, late Assistant Demonstrator at Oxford.

A small collection of *skulls and skeletons* of local mammalia, and a collection of birds' eggs have been commenced by the Natural History Society. There is a small collection of *shells* of land and marine mollusca.

The Insect Collections.—There is at Rugby a collection in process of formation of all the *British Lepidoptera.* Three smaller collections made in various parts of England, and presented to the school, were united together and made the basis of one general collection. This is increased from time to time by boys who collect for it, besides presents from those who have left and who still keep up the study. In the cabinet all those species which are found at Rugby (none but well authenticated captures being recorded) are marked with a letter in red ink, so that the local species may be distinguished at a glance. It is hoped that in time this may be made a fairly complete collection for purposes of study. Any remarkable varieties are especially preserved and placed close to the ordinary specimens of the species.

From time to time presents are made to the museum of cases of foreign insects, but not hitherto on a large enough scale, nor generally in a sufficiently satisfactory state of preservation, to make it worth while to attempt anything like a European collection even of a limited group or number of families. For purposes of study, that is, speaking more precisely, for the observation of the general characteristics of

groups, and the shades of difference by which they gradually diverge, the most instructive method would be to form a European, or even a universal collection of one or more small groups, as for instance, certain well represented and widely distributed families of butterflies: and it is hoped that something of this kind may in future be attempted.

No attempt has yet been made to study any groups of insects except the Lepidoptera. The chief cause of this deficiency is the absence of any cheap or accessible text book on the other orders. But as time goes on, and the Lepidoptera cabinet is filled, it would certainly be desirable to extend the collection to the other orders, at least to the Coleoptera and Hymenoptera.

The whole of the work in this department has been done by the Natural History Society, entirely apart from any school work.

Desiderata.—The teaching of all branches of Natural History at Rugby has been much influenced by the fact that the school possesses no better museum than the small and partial collections above described; for there can be no satisfactory teaching of zoology, nor even of geology, without a zoological collection. When these subjects take a higher place in school education, and are taught by men who have themselves had the advantage of the use of museums, the present state of things will not be tolerated. Among our desiderata must be mentioned in the first place a proper room for a museum. This it is hoped may be found ultimately in the Arnold Library. When the Temple reading room is built, the Arnold Library will be available for a museum and library of books on special subjects, such as the natural sciences and antiquities. It is large enough for both these subjects, at any rate for some years to come, and is a room suitable for a museum, but unsuitable for a reading room or library. But the establishment of such a museum of geology and zoology as would be of real use in school teaching involves considerable expenditure on specimens, on diagrams and printing, and on proper cases for the specimens. And, moreover, no museum would be of much use unless there was a curator in constant attendance, and this costs more money. The Masters have far too much to do to attend properly to the ceaseless work that the care of a museum involves; and a museum only accessible to boys when a Master can afford time to be present would be in practice almost useless. Nor can a museum at school be thrown open to all, without the presence of a curator. Accidents are sure to happen, and the result is endless annoyance.

It is probable that the true functions of a museum at school have yet to be discovered, but it cannot be doubted that in classical antiquities and in Natural History a museum is essential if the boys are to know things at first hand, and when such a museum exists its use will speedily follow. It is not necessary that it should be large, but it is necessary that it should be well selected. The ordinary museum of the present or past day, consisting of two or three bottles of snakes, a stuffed alligator, and two Burmese idols is not instructive, and is not the ideal to be aimed at. Rigorous exclusion of mere miscellaneous curiosities must be the law of the museum.

A larger room is wanted for the use of a Natural History Society, for preparing specimens, &c. for the museum; but it will not be difficult to supply this want.

Among other desiderata must be mentioned a botanical garden, in which the local plants may be arranged in their orders. It is possible that when the new observatory is built, and it is only a question of site

that is causing delay, some part of the ground surrounding it may be made available.

The present writer cannot help expressing his hope that a museum will not long remain a desideratum. A collection sufficient for all school uses could probably be purchased and properly exhibited for £2,500.; and it will be strange if among the wealthy and loyal old Rugbeians some one is not found who will by such a gift perpetuate his name as an enlightened lover both of science and of school.

J. M. W.

Bench Marks. Supplementary Catalogue.

Road from Coventry to Dunchurch.

Mark on North corner of Thurlaston Toll-house, 1.26 ft. above centre of road	374.230
—— on S.W. front of house at junction of road to Thurlaston, with avenue road, 0.51 ft. above centre of road	387.651
—— on stone step at N.E. side of Dunchurch Market Cross, 1.82 ft. above surface	399.529

Road from Dunchurch to Daventry.

Mark on stone over gullet, west side of road (half-way from 79th milestone to stream,) 0.26 ft. below centre of road	288.938
—— on top of coping stone of culvert over stream at east side of road; 0.95 ft. above centre of road	261.219
—— on north-east corner of stable near Windmill, S.W. side of road; 1.17 feet above centre of road	291.923

Road from Dunchurch to Rugby.

Mark on 2nd milestone from Rugby, at junction of roads, 1.66 ft. above surface	400.458
—— on post of gate near small stream, N.E. side of road, 2.06 ft. above surface	355.433
—— on south side of bridge over small stream at south end of Rugby; 0.82 ft. below top of battlement	327.740
Bolt in corner of house at Brick-yard, South end of Rugby, 1.69 ft. above surface	353.247
Mark on angle of Coach-house at Roman Catholic Chapel, 0.66 ft. above surface	372.781

Coventry to Stretton.

Mark on South battlement of Gosford street bridge, Coventry, 2.02 ft. above surface	251.010
—— on South battlement of Binley bridge, over Binley brook, 2.25 ft. above surface	231.053
—— on North West angle of High Wood Lodge, 1.84 ft. above surface	357.729
—— on guide-post at junction of roads; 2.38 ft. above surface	292.171
—— on S.E. angle of Half Moon and Seven Stars Inn, Brinklow; 1.24 ft. above surface	296.859
Bolt in S.W. angle of Brinklow Church tower; 2.89 ft. above surface	330.968
Mark on N. face of South battlement of Stretton bridge over railway, 1.52 ft. over surface	335.155
—— on North West angle of the Red Lion Inn, Stretton; 2.30 ft. above surface	347.973

Road from Pailton to Rugby.

Mark on N.E. corner of the White Lion Inn, Pailton Village; 1.33 ft. above surface	380.912
—— on Guidepost at junction of roads to Churchover and Easenhall, 2.01 ft. above surface	383.322
—— on Guidepost at junction of road to Easenhall, 2.91 ft. above surface	372.052
—— on West face of East battlement of bridge over Canal, 0.32 ft. below top of battlement	321.004
—— on Gate-pier at entrance to Mr. Walker's house, West side of road, 1.74 ft. above surface	280.881
—— on East battlement of Old Station bridge, 1.75 ft. above surface	278.811

The following are the Certificates of our Meteorological Instruments received from the Kew Observatory.

Barometer by Casella, London. Standard 615.

Compared with the Standard Barometer of the Kew Observatory.

Correction (including capillary action) = + 0.002 inches.

Kew Standard Thermometer No. 457.

Verified unmounted, and in a vertical position.

Corrections to be applied to the Scale Readings.

Correction at 32° 0.0
„ „ 212° 0.0

Maximum Thermometer No. 12970 by Casella, London.

Verified unmounted.

Corrections to be applied to the Scale Readings, determined by comparison with the Standard Instruments at the Kew Observatory:—

At 32° .... — 0.0
42° .... — 0.0
52° .... + 0.1
62° .... + 0.1
72° .... + 0.1
82° .... — 0.1
92° .... + 0.1

Minimum Thermometer No. 11286 by Casella, London.

Verified unmounted and in a vertical position.

Corrections:—At 32° .... — 0.0
42° .... + 0.2
52° .... + 0.2
62° .... — 0.0
72° .... — 0.2

Note.—As Alcohol wets the capillary glass tube and is very volatile, this instrument ought occasionally to be examined in order to ascertain that there is no liquid above the main column. If there should be some condensed in the top of the tube, by slightly heating this it will be driven down so as to join the main column.

Thermometer No. K. O. 12518 by Casella, London.

Corrections:—At	32°	— 0.0
	42°	— 0.0
	52°	— 0.0
	62°	— 0.0
	72°	— 0.0
	82°	— 0.0
	92°	— 0.0

Thermometer No. K. O. 12519 by Casella, London.

Corrections:—At	32°	+ 0.1
	42°	— 0.0
	52° ...	— 0 0
	62°	— 0.0
	72°	— 0.0
	82°	— 0 0
	92°	— 0.0

Thermometer No. K. O. 12520 by Casella, London.

Corrections:—At	32°	— 0.0
	42°	— 0.0
	52°	— 0.0
	62°	— 0.0
	72°	+ 0.1
	82°	+ 0.1
	92°	+ 0.1

Thermometer No. K. O. 12521 by Casella, London.

Corrections:—At	32°	— 0.0
	42°	+ 0.1
	52°	— 0.0
	62°	— 0.0
	72°	+ 0.1
	82° ...	+ 0.1
	92°	+ 0.1

Note.—I. When the sign of the Correction is +, the quantity is to be *added* to the observed scale reading, and when — to be *subtracted* from it.

II. The length of air speck has been taken into account in determining the above corrections (in the maximum Thermometer).

III. Mercurial Thermometers are liable, through age, to read too high; this instrument ought, therefore, at some future date, to be again tested at the melting point of ice, and if its reading at that point be found different from that now given, an appropriate correction ought to be applied to all the above points.

KEW OBSERVATORY,
January, 1871.

pro B. STEWART,
T. W. BAKER.

The following account is of sufficient interest to be reprinted and preserved:—

Rugby Advertiser Extra. Saturday, February 22, 1862.

Mr. Hawkesley's Report upon the Boring for Water.

AT the Meeting of the Board of Health this morning, the following Report from Mr. Hawkesley upon the Boring for Water was received and read:—

"LONDON, FEB. 1862.

"GENTLEMEN,—I have the honour to present my Report upon the Boring for water which has been undertaken by you at my suggestion, with the object and purpose of increasing the present very inefficient supply of water to the Town of Rugby; and I have to apologize for having for some time delayed my statement, in the hope that I might have obtained such additional information as would have enabled me to present a more favourable statement than it is now possible to offer.

"The boring, of which I annex a carefully-drawn section,* has undoubtedly penetrated to the Water-Stones of the New Red Sand-stone formation; and would, I have no doubt, yield an abundant supply of water if it were deemed worth while to perforate these beds to a somewhat greater depth. It seems, however, that in this particular locality there unexpectedly exists a deposit of rock salt, which, becoming dissolved in the water brought up by the bore-hole, communicates to it a degree of brackish salinity which renders it totally unfit for food, as well as for all domestic and public purposes, with the single exception of those descriptions of baths in which salt water can be used with advantage.

"From analyses made by Dr. Odling, a copy of whose report I annex, it appears that the strength of the brine had been gradually increasing, till at length the total solid contents amounted to 1256 grains in a gallon, of which not less than 777 grains consisted of chloride of sodium, or common salt. I am of opinion that this result, large as it is, does not by any means represent the strength to which the spring would be found to attain, if the water-yielding beds were to become perforated to a more considerable depth; for at present the boring does not appear to have penetrated more than five or six feet into the rock from which the stream proceeds.

"Since the unfortunate discovery of the existence of a bed, or perhaps more probably of a basin, of rock salt in this locality, I have had interviews with Professor Ramsay and other eminent geologists, and have carried on an anxious research, with the view of ascertaining the reasonable probability of drawing a supply of purer water from any stratum lower than that to which the bore-hole has yet reached, and I am bound to state that I have not been able to meet with one well-authenticated fact which would warrant me in holding out to the Board the expectation of obtaining a useable supply, if indeed it exist in that locality, within those limits of expense which the circumstances of their trust would appear to warrant. It is quite true that the next subjacent formation—the permian—is often most abundantly productive of water, for I have myself sunk shafts into it from which many million gallons are being daily withdrawn, but this stratum lies many hundred feet

* See the diagram of the whole boring, in our Report for 1868, copies of which may be had for 6d. by applying to the President.

below the bottom of the bore-hole, and cannot therefore be reached except by a special and costly apparatus, and then only after such an enlargement and alteration of the piping as would involve a very considerable expenditure of time and money.

"This is the first occasion on which it has been my misfortune to fail in an engineering operation, and though it was undoubtedly not possible for me to ascertain by any previous investigation the localization of rock salt in the neighbourhood of Rugby, it is not the less a matter for sincere regret and much mortification on my part, and I feel the result the more keenly because, after much labour, delay, and expenditure, the Board were beginning to realize the success of the experiment as a means of supplying the numerous population within their district with an adequate quantity of one of the first necessaries of life.

"In my first communications with the Board, I had the honour to state my decided opinion that the River Avon was the only feasible source from which an additional supply could be obtained, and it was only after the repeated statement of the members of the Board that the absence of Parliamentary powers and the determined opposition of the owners of mills on that stream rendered a resort to that source impossible, that I was induced to suggest that relief from the then existing difficulties might possibly be obtained by carrying a bore-hole down to the water-bearing strata of the New Red Sandstone.

"A large sum of money has, under the circumstances stated, been uselessly expended, and consequently I feel it almost a duty to assist the Board to the utmost of my power in applying what I believe to be the only available remedy for the scarcity of water under which the Town of Rugby is now and has been for so long past suffering. I have therefore pleasure in stating that if the Local Board of Health think fit to resort to the River Avon, I will willingly defray the engineering expenses of the necessary application to Parliament, and will design and superintend the construction of the works to be made in the event of the Act being obtained, without charge or cost to the community.

"I have the honour to be, Gentlemen,

"Your most obedient servant,

"T. HAWKESLEY.

"The Local Board of Health, Rugby."

"Laboratory, Guy's Hospital,

"Dec. 27, 1861.

"MY DEAR SIR,—Herewith I send you the results of my preliminary analysis of the Rugby water.

Sample No.	I,	982	Grains of Saline Matter per Gallon.
" No.	II,	1092	
" No.	III,	1256	

"By this you will perceive that the degree of salinity has gone on increasing regularly. Of the 1,256 grains per gallon of the last sample, 777 grains consisted of common salt. The remaining constituents were principally Sulphate of Soda or Glauber's Salt, and Sulphate of Magnesia or Epsom Salt. There was also a small proportion of Carbonate of Lime, with traces of Bromine, Iodine, and Lithium.

"Until the water has arrived at something like a constant degree of salinity, it will be perfectly useless to make a quantitative analysis of its constituents. Moreover its general character is clearly shown by the above results.

"Thus the water is evidently quite unfitted for domestic use.

"Unless its salinity should increase very greatly, it is also unfitted to serve as a brine spring, from which to manufacture common salt, &c.

"It seems, however, well adapted for use as a mineral or medicinal water. It would doubtless prove an efficient saline purgative, and the small quantities of Bromine, Iodine, and Lithium which it contains would enhance its therapeutic reputation.

"I am, dear Sir, yours very truly,
(Signed,) "WILLIAM ODLING."

"Thos. Hawkesley, Esq."

The following valuable record of rainfall in Rugby from 1855—1862, kept by Mr. Fuller, has been kindly placed at our disposal:—

Table of Rainfall in Rugby during the last Eight Years.

	1855	1856	1857	1858	1859	1860	1861	1862	Average.
Jan.	·069	2.922	2·639	·283	1·094	2·557	1·368	2·287	1·652
Feb.	·995	1·653	·759	·982	1·455	·835	1·523	·388	1·074
March	1·218	·665	1·887	·619	1·410	1·894	2·068	3·578	1·667
April	·570	1·693	2·510	2·467	1·936	1·208	·548	1·562	1·562
May	1·187	2·780	·849	1·918	1·230	2·958	1.033	2·344	1·787
June	2·412	1·395	2·234	1·360	2·507	5·358	1·876	3·316	2·557
July	6·818	1·527	2·262	1·756	1·385	1·400	4·624	1·887	2·707
Aug.	1·218	1·649	3·840	2·216	2·226	3·160	·856	1·900	2·133
Sep.	1·033	1·523	3·873	2·170	1·788	2·506	1·968	3·282	2·268
Oct.	4·459	1·722	2·182	2·155	2·420	2·293	1·228	2·592	2·381
Nov.	1·164	1·345	1·564	·453	1·883	2·013	2·510	·748	1·460
Dec.	·671	1·674	·610	2·035	1·753	1·355	1·217	1·301	1·327
Total Ins.	21·814	20·548	25·209	18·414	21·087	27·537	20·819	25·185	22·577

NUMBER OF DAYS IN EACH MONTH AND YEAR ON WHICH RAIN, SNOW, OR HAIL FELL.

	1855	1856	1857	1858	1859	1860	1861	1862	Monthly & Yearly Average.
Jan.	12	19	17	5	17	20	10	17	15
Feb.	12	16	8	6	14	11	17	12	12
March	14	8	12	13	16	21	15	23	15
April	7	12	13	11	14	14	4	16	11
May	8	17	10	15	9	16	6	12	12
June	10	10	9	8	12	23	16	21	14
July	16	9	11	12	9	10	24	15	13
Aug.	16	18	7	13	10	20	13	9	13
Sept.	6	22	13	17	13	13	15	11	14
Oct.	20	19	13	17	14	13	16	17	16
Nov.	17	13	9	10	14	18	16	12	14
Dec	14	14	9	20	11	15	14	14	14.
Total days	152	177	131	147	153	194	166	179	163

NOTE.—Between the 22nd and 29th March, 1862, there was such an unusual quantity of rain, that a Table is given, showing the fall in the corresponding week in the seven preceding years :—

1855	1856	1857	1858	1859	1860	1861	1862
·090	·000	·116	·009	·062	·324	·000	1·812

FREDK. FULLER.

Rugby, 1st January, 1863.

The following is a list of Minerals presented to the Museum by J. M. Wilson, Esq. They were found chiefly in the Harz District.

1. Agate. — Rubeland, Hartz
2. Alabaster — Hartzungen, Hartz
3. Amethyst — Ilfeld, Hartz
4. Analcime — Andreasburg, Hartz
5. Anhydrite — Eisleben
6. Anthracite — Rubeland, Hartz
7. Anthraconite — Wernigerode, Hartz
8. Stibnite — Wolfsburg, Hartz
9. Cervantite (Antimony ochre) — "
10. Apophyllite — Andreasburg
11. Arsenic (native reniform) — "
12. Mispickel — Hasserode, Hartz
13. Asbestos — Tresseburg, Hartz
14. Asphaltum — France
15. Augite — Bohemia
16. Axinite — Schierke, Hartz
17. Quartz — St. Gotthardt
18. Bergholz (Rock wood, var. of asbestos) — Buchenberg, Hartz
19. Mountain leather (var. of asbestos) — Alps
20. Pumice — Italy
21. Galena, with Chalybite — Neudorf, Hartz
22. Galena, with Pearl spar. — Clausthal, Hartz
23. Compact Galena — "
24. Bournonite — Neudorf
25. Limonite — Elbingerode, Hartz
26. Calcite — "
27. Brown Spar — Ilfeld
28. Brown Spar — Clausthal
29. Bronzite — Baste, Hartz
30. Purple Copper (Erubescite) — Lauterberg, Hartz
31. Carnelian — Fassathal, Hartz
32. Chabasite — Andreasberg
33. Chalcedony — Hasserode
34. Chlorite — Buchenberg
35. Celestine — Jena
36. Datholite — Andreasberg
37. Stilbite — "
38. Calcite — "
39. Flos-ferri (var. of aragonite) — Elbingerode
40. Specular iron ore (var. of Hæmatite) — Elba
41. Micaceous iron ore — Ilfeld
42. Ferrugineous quartz — Buchenberg
43. Red ochre (earthy hæmatite) — "
44. " — "
45. Copperas (Ferrous sulphate) (coated with ferric sulphate) — Goslar, Hartz
46. Tetrahedrite — Clausthal
47. Fibrous gypsum — Wernigerode
48. Feather ore (heteromorphite) (Sulphide of lead and antimony) — Andreasberg
49. Felspar — Hirschberg
50. Flint — Wernigerode
51. Fluor spar with chalybite — Stolberg
52. Calamine — Aachen
53. Copper glance — Lautersberg
54. Mica — Harzburg
55. Gold — Columbia
56. Garnet — Ilmenau
57. " — Andreasberg
58. Graphite — Bohemia
59. " — Elbingerode
60. Pyromorphite — Clausthal
61. Dufrenite (phosphate of iron) — Hirschberg
62. Selenite — Wernigerode
63. " — Steigerthal
64. Tremolite — Tyrol
65. Selenite — Drubeck
66. Semi-opal — Hanau, Hartz
67. Hauyne (in lava) — Vesuvius
68. Hausmannite — Ilfeld
69. Millerite (sulphide of nickel) — Andreasberg
70. Heulandite — Fassathal
71. Mellite — Artern
72. Hornblende — Arendal
73. Jacinth (var. of zircon) — Zeilau
74. Calcareous tufa (sinter) — Elbingerode
75. Calcite — Andreasberg
76. " — "
77. " — Neudorf
78. Calcareous tufa — Kronigslutter
79. Cat's eye (var. of chalcedonite quartz) — Treseburg
80. Erythrine (cobalt bloom) — Hasserode
81. Harmotome (cross stone) — Andreasberg
82. Native copper — Lauterberg
83. Chrysocolla — "
84. Copper pyrites (chalcophyrite) — Clausenthal
85. Azurite (carbonate of copper) — Lauterberg
86. Chalcotricite (var. of cuprite) — "
87. Copper Nickel — Andreasberg
88. Kupferpecherz (chrysocolla and brown iron ore) — Lauterberg
89. Slaty copper ore — Mansfeld
90. Conite (var. of dolomite) — Hessen

91.	Labradorite	Finnland
92.	Lepidolite (Lithia mica)	Mahren (Moravia)
93.	Leucite	Piedmont
94.	Lieorite	Elba
95.	Lazurite	Steyermark
96.	Magnetite	Attenau
97.	Malachite	Australia
98.	Melanite (Black garnets)	Kaiserstuhl
99.	Mesolite	Eschwege
100.	Molybdenite	Saxony
101.	Manganite	Ilfeld
102.	Nickel ochre	Bieber
103.	Olivine	Eifel
104.	Pitchstone	Heifsen
105.	Pharmacolite (arseniate of lime)	Richelsdorf
106.	Phillipsite	Hessen
107.	Phosphocalcite	Breitenbach
108.	Pinite (altered iolite)	Elbingerode
109.	Epidote (Pistacite)	Schierke
110.	Porcelain Jasper	Almerode
111.	Praseolite (altered iolite)	Brevig
112.	Pyrolusite	Ilmenau
113.	Pyrope (var. of garnet)	Bohemia
114.	Quartz	Hasserode
115.	Hepatic Cinnabar	Idria
116.	Realgar	Andreasberg
117.	Rhadonite (silicate of manganese)	Elbingerode
118.	Rose Quartz	Bavaria
119.	Red Hæmatite	Lauterberg
120.	Red ochre (var. of red hæmatite)	Büchen
121.	Pyrargyite	Andreasberg
122.	Cuprite (red copper ore)	Australia
123.	Scheelite	Neudorf
124.	Schiller spar	Baste
125.	Schorl	Andreasberg
126.	Sulphur	Cracow
127.	Iron pyrites (pyrite)	Drübeck
128.	Iron pyrites	Clausthal
129.	Heavy spar (Baryte)	"
130	Selenide of copper and lead	Zorge
131.	Onofrite (selenide of Mercury)	Clausthal
132.	Silver ore	Andreasberg
133.	Chalybite (carbonate of iron)	Neudorf
134.	Steatite	Drübeck
135.	Smaltine	Hasserode
136.	Sphene	Tyrol
137.	Spinel	Sweden
138.	Lithomarge	Ilfeld
139.	Rock salt	Wilitzka
140.	Stilbite	Andreasberg
141.	Strontianite	Clausthal
142.	Actinolite	Tyrol
143.	Serpentine	Zoblitz
144.	Antimonial silver (Stephanite)	Clausthal
145.	Topaz	Mexico
146.	Talc	Tyrol
147.	Idocrase (Vesuvianite)	Piedmont
148.	Wad	Bächenberg
149.	Cerusite (stained with cupric carbonate)	Clausthal
150.	Bismuth	Hasserode
151.	Wolfram	Zinnwald
152.	Pharmacosiderite (Arseniate of iron)	Cornwall
153.	Xanthosiderite	Ilmenau
154.	Yttrotantalite	Ytterbi
155.	Calamine	Attenberg
156.	Cassiterite	Cornwall
157.	Cinnabar	Bavaria
158.	Zinc blende	Clausthal
159.	"	Neudorf
160.	Tinder ore (impure arsenical sulphide of antimony and lead)	Clausthal

The following list of Lepidoptera noticed in the Harz district July 28—Aug. 15, 1874, has been kindly communicated to us by C. H. Wilson, Esq. [Those that were common are marked ! those that were abundant ! !].

	Date.	Locality.	Altitude.
Pieris Brassicæ ! !	all	all	all
Rapæ ! !	"	"	"
Napi ! !	"	"	"
Gonepteryx Rhamni !	"	various	1,000 ft.
Chrysophanus Phlæas !		foot-hills and slopes	
? a tailed species	Aug. 7	Kohlenschacht Selkethal	plain level
Polyommatus Alexis ! ? others		various	
Limenitis Sibilla	Aug. 5	Treseburg, Brolethel	600
Brgynnus Paphia ! !		abundant	1,200 ft.
Aglaia !			
Adippe		Selkethal and Tanzplatz	
Selene			
Melitæa Artemis			
Athalia			
Vanessa Atalanta		Okerthal	
Io ! !			
Antiopa		Okerthal and Selkethal	

	Date.	Locality.	Altitude.
Vanessa Urticae!			
? Polychloros		Tanzplatz	
C. Album			
Apatura Iris		Victorshöhe	
Arge Galathea		Selkethal	
Erebia Blandina!!		Hazel-scrub, &c.	500—1,500 ft.
Satyrus Semele		moors and high levels	
Janira			
Tithonus!		Selkethal, &c.	
Megæra			
Ægeria		cover, Treseburg	
Hyperanthus		do.	
Davus		Falkenstein, Selkethal	
Pamphilus!			
Pamphila Linea!		plain, &c.	
Sphinx Pinastri	Aug. 30	pine stem, Upper Okerthal	1,000 ft.
Anthrocera? Filipendulæ		Georgeshöhe	900 ft.
Œnistis Quadra	Aug. 4	Altenbrack	1,000 ft.
Arctia Caja		Elbingerode	600 ft.
Liparis Monacha	Aug. 7	Magdesprung, Selkethal	
Notodonta Dictaea	Aug. 5	Treseburg	600 ft.
Bryophila Perla	Aug. 3	Wernigerode	
Acronycta Leporina	Aug. 2	Ilsethal	500 ft.

The chief captures were

(1) foot of Okerthal, July 30
Alexis Paphia!! Aglaia Janira! Hyperanthus
Quasi-Semele. Rhamni! Urticæ!!
Comma, Atalanta, Antiopa, Linea, Pinastri.

(2) Bodethal, Altenbrack, Treseberg, Aug. 5.
Sibilla Hyperanthus Paphia, &c.
(Hazel-scrub low down, near the river.)

(3) Selkethal, Falkenstein, Magdesprung, a scree about ¼ mile above former, was alive with sundry and various, from Antiopa to Pamphilus, abundance of some Arctia, not Dominula.

Extract from a work by Messrs. C. André and G. Rayet, (Astronomers of the Paris Observatory,) on 'Practical Astronomy and the Observatories in Europe and America, from the middle of the 17th Century to the present time.'

Observatoire de l'école de Rugby (Rugby.)

Cet Observatoire a été fondé tout récemment, en 1872, à la mémoire de l'évêque actuel d'Exeter, dernier chef supérieur de l'école de Rugby.

L'Observatoire de Rugby est bien plutôt une sorte d'annexe complémentaire de l'école, une sorte de laboratoire astronomique, où les étudiants peuvent compléter leurs études théoriques, qu'un Observatoire véritable. Il se compose actuellement de deux salles d'observations: l'une qui contient un équatorial de 8,25 pouces

d'ouverture, construit par Alvan Clark, et un télescope réflecteur de 12 pouces, sortant des ateliers de M. With; l'autre est une chambre noire pour les observations spectroscopiques.

MM. Wilson et Seabroke, professeurs à l'école de Rugby, dirigent les travaux de ce petit établissement et surveillent l'éducation astronomique des étudiants. Ils font, en outre, un certain nombre d'observations: ainsi M. Seabroke étudie régulièrement le spectre des protubérances solaires, et en compare les raies avec celles que donne la flamme de l'hydrogène ou de l'azote à différentes pressions, et, de concert avec M. Wilson, il fait un grand nombre de mesures d'étoiles doubles.

Nous avons parlé de cet Observatoire, malgré son peu d'importance actuelle, pour montrer combien il est facile de créer un établissement utile avec de faibles ressources; en France, bien certainement, nombre de Facultés pourraient suivre cet exemple, et préparer le recrutement, si difficile aujourd'hui, de notre personnel astronomique.

Description of the Plates.

Plate 1 is a drawing by C. Kerr, Present Rugbeian, of a fossil Labyrinthodon in coal. See Mr. Wilson's note in the Geological Report, page 52.

Plate 2 is a heliotype copy of a drawing by J. H. Patry (at the time a member of the School), which itself was a copy carefully made of 15 various observations of Planet Mars, taken at the Temple Observatory. The observers were Mr. Wilson (W., or J. M. W.), Mr. Worthington (at the time a member of the School, A. M. W.), and Mr. Seabroke (G. M. S.) The plate is presented by Mr. Wilson.

By an inadvertence, the last 4 drawings have been placed in a different position from the rest. For purposes of comparison they should be shifted through an angle of about 30° in the direction of rotation of the hands of a watch. It will then be seen that the drawing of May 15, 1873, is comparable with that of May 8, 1871, and the one of June 16, 1873, has some points of resemblance to that of May 13, 1871.

Plate 3 contains three curves drawn by H. F. Newall (M), with a Compound Pendulum machine of his own construction. (See p. 2, and Plate 4.) See also Preface, p. iv.

The proportions of the pendulums are, in the top curve 64 : 65, in the second 34 : 65, in the third 25 : 65.

Plate 4 contains at the top a drawing by H. N. Hutchinson (M) of a Roman lamp and Praefericulum found near Rugby. The paper describing them was read by L. Knowles (M), and will be found p. 35.

Below is a drawing by H. F. Newall (M) of his Compound Pendulum machine, described on p. 2.

Plate 5 contains 5 drawings by H. F. Newall (M), to illustrate a paper by him on 'Drops,' which is printed in the Report, p. 38.

Plate 6 is a copy of Mr. Wilson's map of the Hillmorton fault, described at length in his paper on the Geology of the District, p. 8. The copy was made by C. Kerr.

Plate 7 is a sketch by R. D. Oldham (M) of a section on the Lawford Road. It is described in the Geological Report, p. 52.

Plates 1, 4, 5, 6, 7, are Anastatic Etchings.

It will be observed that the whole of the drawings done for these plates are the work of Present Members of the School, or those who were so at the time.

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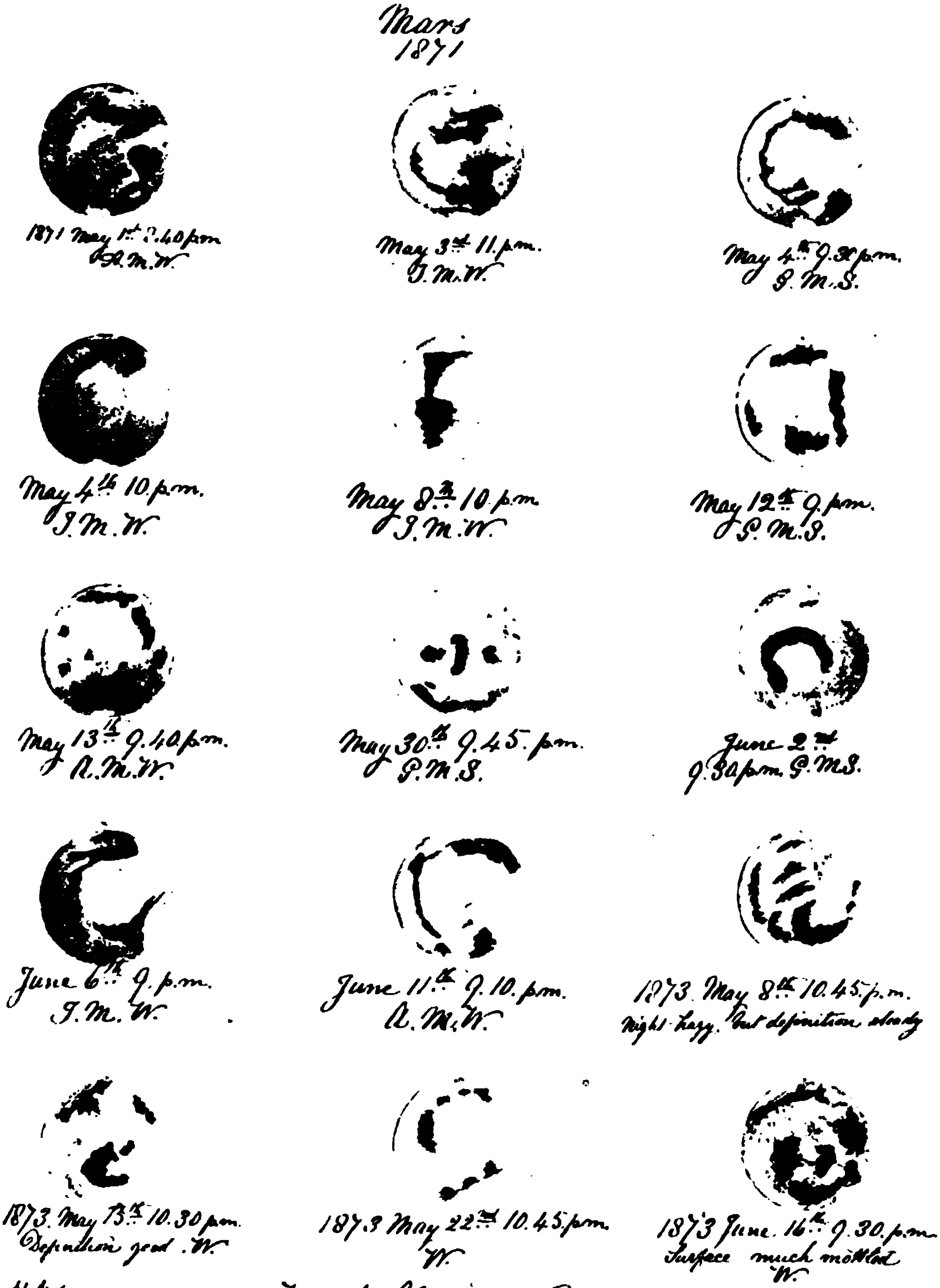
... del.

LABYRINTHODON,

on a slab of coal from the Lower Irish Coal Me

[Given by J. R. Allen.]

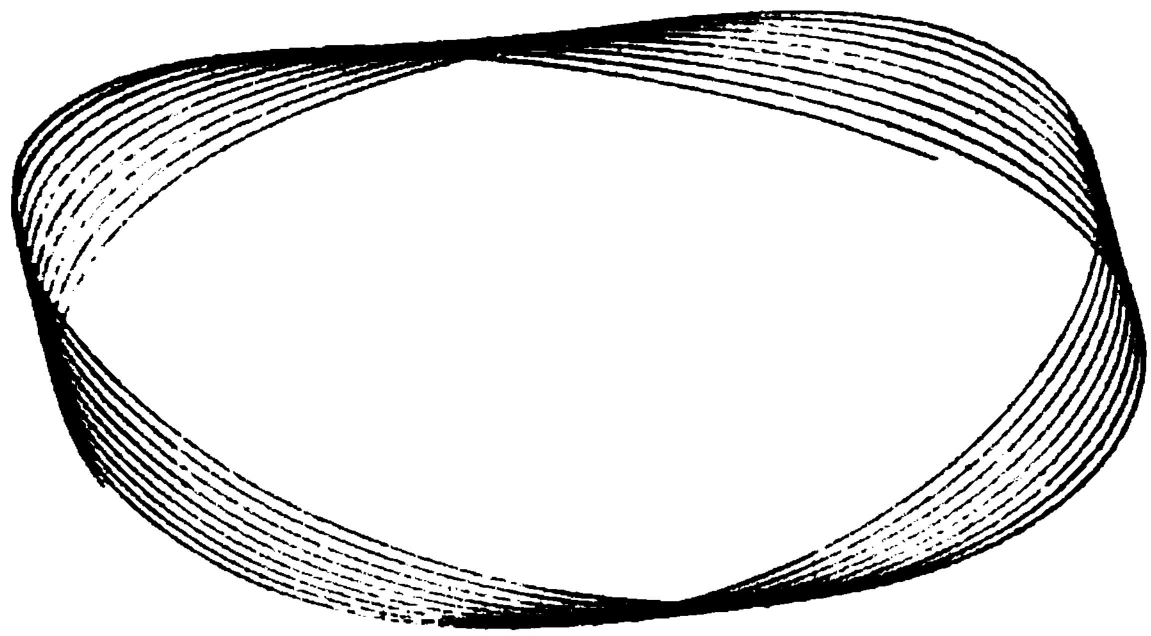
Plate 2

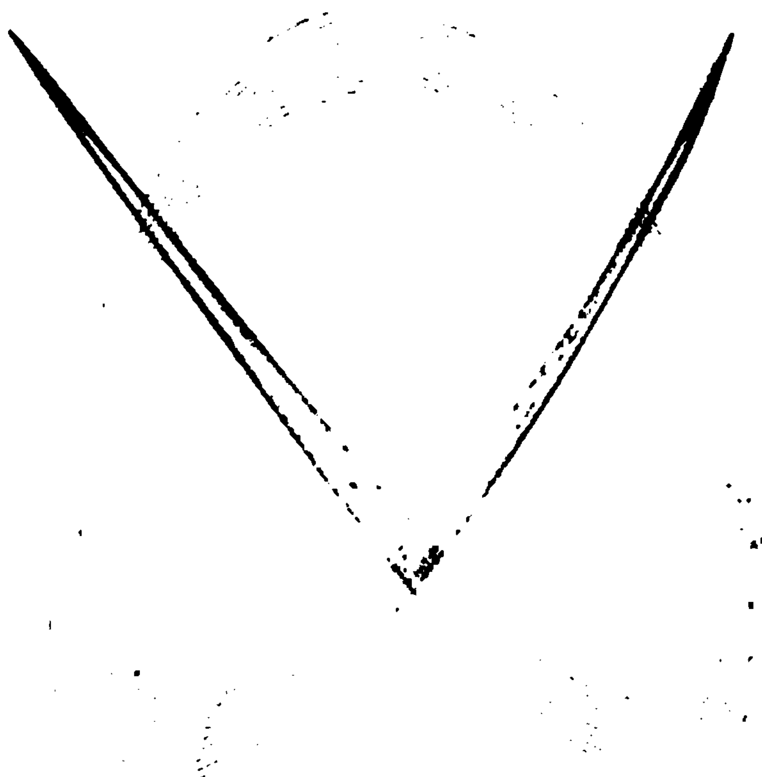


Heliotype

Temple Observatory. Rugby

Plate 3





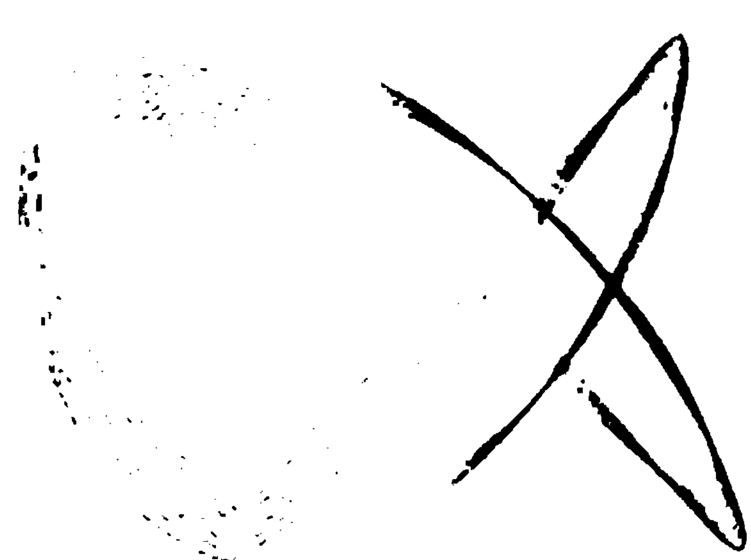


Plate 4.

Roman Lamp and Præfericulum.

T.H. Hutchinson del^t.

The Compound Pendulum Machine.

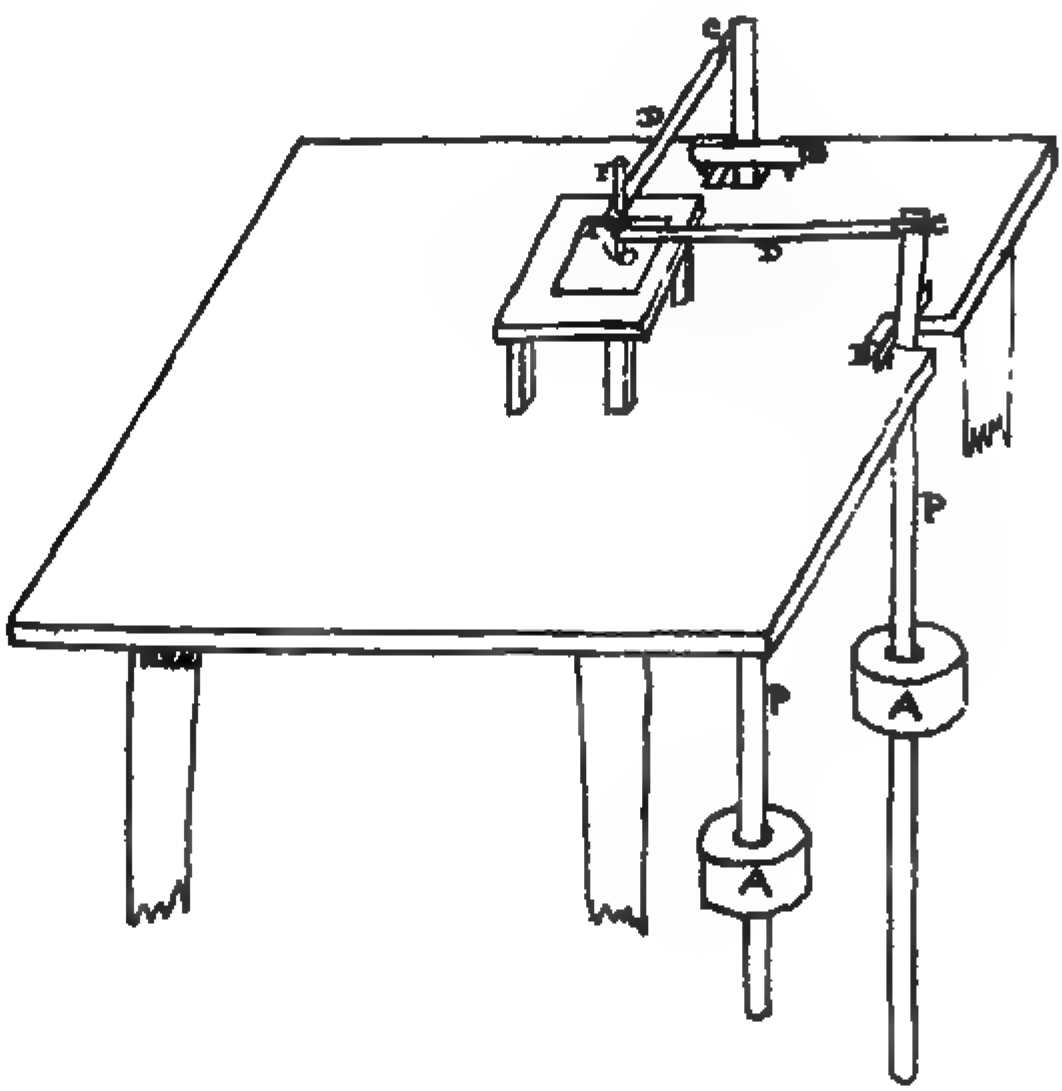


Fig. 1.

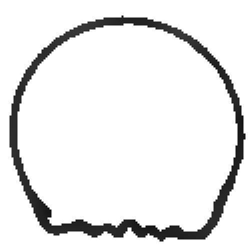


Fig. 2.

Fig. 3.

Fig. 4.

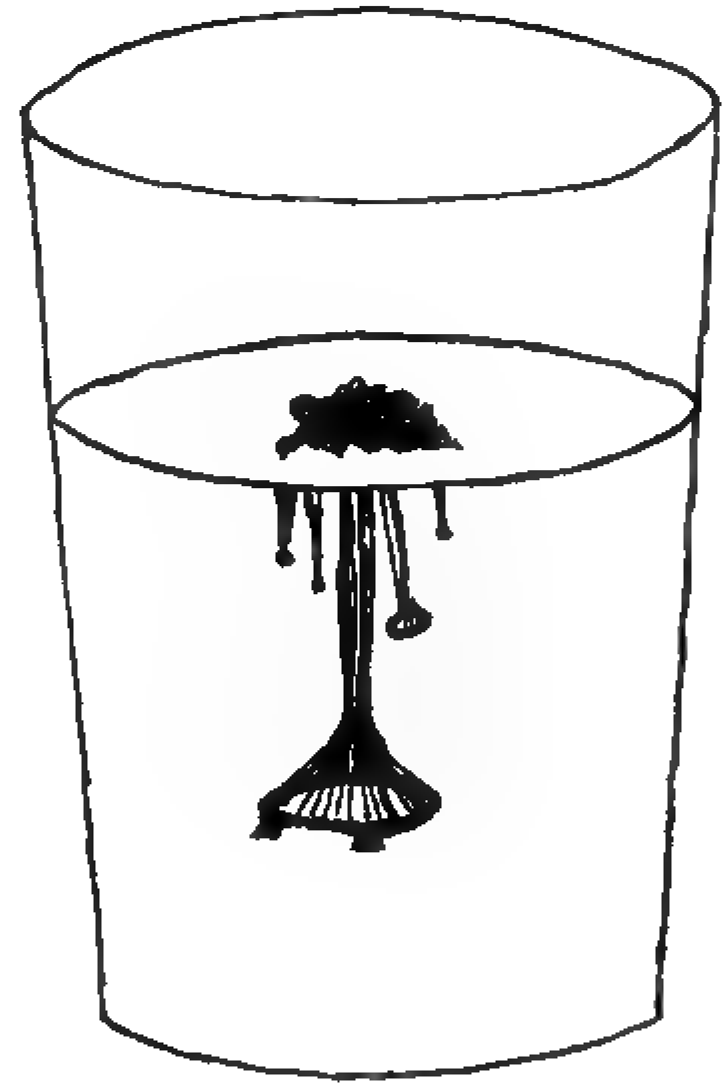
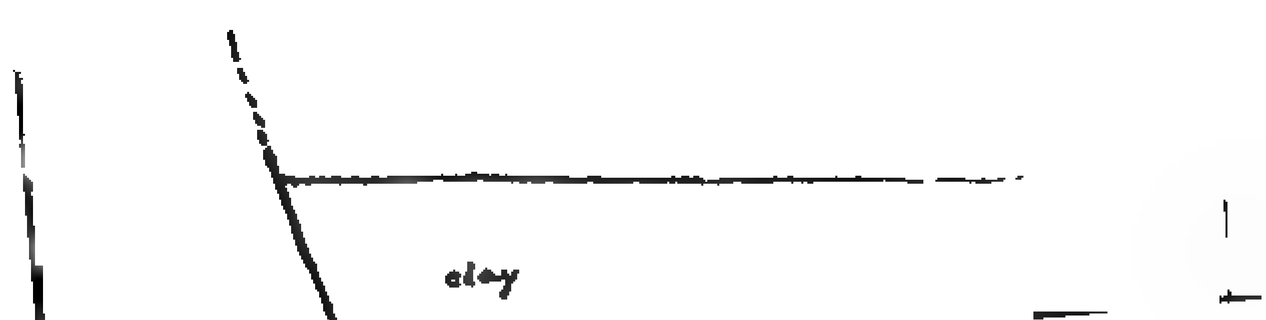
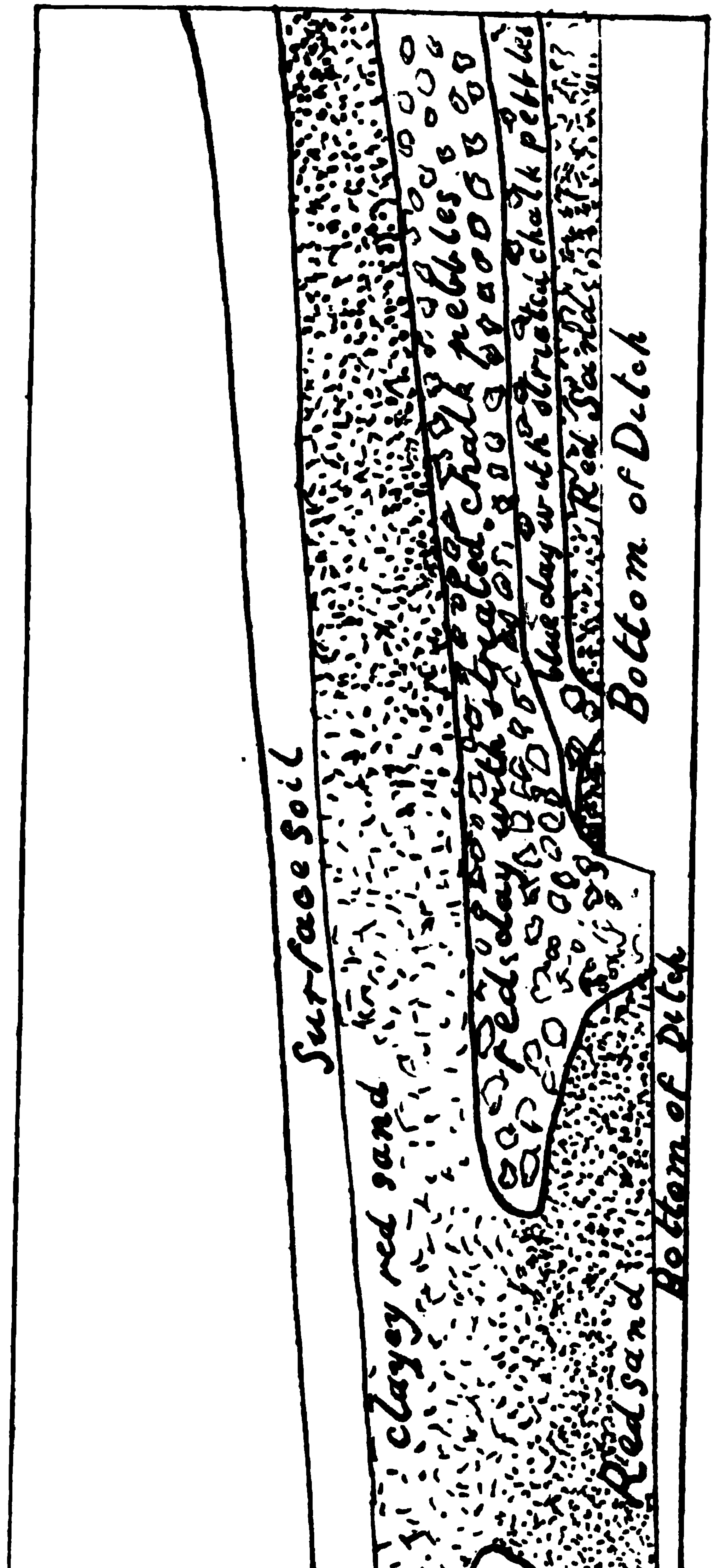


Fig. 5.


clay



R D Oldham. del

REPORT

OF

THE RUGBY SCHOOL

NATURAL HISTORY SOCIETY

FOR THE YEAR

1875.

"IIS QUIBUS NON CONJICERE ET HARIOLARI SED INVENIRE ET SCIRE PROPOSITUM EST, OMNIA A REBUS IPSIS PETENDA SUNT."

—BACON.

RUGBY: W. BILLINGTON.
1876.

PREFACE.

In apologizing to our readers for our somewhat tardy appearance, we may perhaps be allowed to urge as an excuse that the present Report is the largest yet issued by our Society. It will be observed also that we have this year no fewer than 10 Plates, eight of which are drawn by present members of the Society, and one by our late Secretary, of whose valuable services we have only just been deprived.

We regret to say, however, that this increase is not due to any progress in our Sectional Reports, which have on the contrary declined. It is to be attributed rather to the large number of Papers read last year which were of sufficient interest to be printed. This is a matter of congratulation: for though the real work of the Society has fallen into a few hands, those few have been so energetic that we think our Report will compare not unfavourably with others of previous years.

A review of the Sectional work may be briefly given as follows.

The Botanical Section, though reduced to one member, has done excellent work. The list of local plants, promised last year, has at length been completed: but it has proved so large and important a work that we have decided to publish it separately, and we hope to get it out before Midsummer. It will contain the result of nine years' patient observation and record. The Society will scarcely need to be told that much as this work owes to Mr. Kitchener, it owes scarcely less to H. W. Trott, who has latterly indeed laboured unassisted to complete it.

The Entomological Section has improved this year. There are more of them, and they have recorded more. There is still scope for much more careful and complete observation. Encouragement has been recently given to this branch of our work by two munificent gifts. Lord Dormer has presented us with a splendid collection of beetles, which is now in course of transference to our own cases: and our old friend, Mr. Robertson of Harrow, has given us a generous donation of £10, which has been spent in a good cabinet to contain foreign Lepidoptera. Both these gifts are most welcome, having long been among the desiderata of the Society: and we take this opportunity of expressing once more our thanks to our kind benefactors.

The Geological Section has practically been in abeyance. Mr. Wilson's illness and absence, which was in so many ways felt as a grievous misfortune, was fatal to this portion of our work; following as it did on the unexpected loss of R. D. Oldham, who had been a most useful member. We hope next year to find the Section in renewed vigour.

The Zoological Section has also lapsed. The last Album Keeper has found the pressure of other cares too great, and has reluctantly retired. A successor has however at length been found, and we hope in this respect also to see progress next year.

The Meteorological Section has been in full work, and its useful record is given as usual in our Appendix. There is rather an unusual number of inaccuracies in the entries, which is a pity, though we suppose it is difficult to avoid: it is fortunate however that the rainfall record is not affected, as there one inaccuracy spoils the total. We give this year not the readings of the wet and dry bulbs, but the difference between the two; a change which is in many ways a convenience.

Through the kindness of Mr. S. Haslam of Uppingham, we have been enabled to enjoy this Term the use of his splendid aquarium, five feet long, and built of solid slate and glass. It has been already started, and is by the energy of the curator, C. Bayley, (M), and the kindness of several friends, a decided success.

In conclusion we must say a word of sincere regret for the loss of H. Vicars, especially since he has had to leave prematurely in consequence of ill health. No member of the Society has done more steady and valuable work for us, or written better Papers.

A. SIDGWICK, } *Editors.*
H. F. NEWALL, }

MAY, 1876.

ACCOUNTS.

January, 1875—*May*, 1876.

Cr.	£.	s.	d.		£.	s.	d. Dr.
Balance, see last Report	6	15	4	Plates, printing	6	8	6
Members' Subscriptions	22	17	6	Books and Periodicals	10	13	4
Sale of Reports	2	1	0	Heliotype	2	1	3
Botanical Paper sold	0	8	0	Prize	2	0	0
Discount on Prize	0	4	0	New Cabinet (from Meek's)	10	10	0
Donation by Rev. J. Robertson	10	0	0	Expenses, for the Model	2	10	0
				Balance carried forward	8	2	9
	£42	5	10		£42	5	10

ADDRESSES.

Anastatic Printing, and Materials: Mr. Cowell, Buttermarket, Ipswich.

Heliotype Printing: Messrs. Gilbert and Rivington, Lincoln Terrace, Kilburn, N.W.

Entomological Apparatus: J. Gardner, 52, High Holborn, London.

E. G. Meek, 56, Brompton Road, London, S.W.

RULES.

I.

That this Society be called "THE RUGBY SCHOOL NATURAL HISTORY SOCIETY."

II.

That the Society consist of Honorary Members, Corresponding Members, Members, and Associates.

III.

That Masters, and others connected with the School, or any Benefactor of the Society, be eligible as Honorary, and Old Rugbeians as Corresponding Members; that Present Rugbeians be eligible as Members, or Associates.

Of Officers:

IV.

That the Society's Officers consist of a President, Secretary, and Curator, and of the Keepers of the several Albums, and that these do form the Committee of Management, three to be a quorum.

V.

That all Officers be elected annually.

VI.

That when any office is vacant, the Committee do recommend a Member or Associate, or (for the office of President) an Honorary Member, for election by the Members of the Society, and that the election be by scrutiny.

VII.

That the President take the chair at all Meetings, but have no vote except in cases of equality.

VIII.

That the Secretary keep the Minutes of the Society's proceedings; keep a list of the existing Society, with the names and addresses, as far as possible, of all Corresponding Members, and a list of all Benefactors of the Society.

IX.

That the President and Curator form a Sub-Committee, for managing the finances and keeping the property of the Society.

X.

That the duty of the several Album Keepers be to call together Sectional Meetings; to receive all notices connected with their several Sections; to enter all occurrences of interest in their Album; and at the end of each year to furnish a Report of what has been done in their Section during the year.

XI.

That in the absence of any Officer, the Committee appoint a Deputy.

Of Honorary and Corresponding Members:

XII.

That Honorary Members be elected by open vote of the Society; pay an entrance fee of 10s. but no subscription unless specially called upon; and have all the privileges of Members, except that of voting: but that Benefactors of the Society who are elected Honorary Members be excused the entrance fee.

XIII.

That Corresponding Members be elected by open vote of the Society, without entrance fee, and have all the privileges of Members, except that of voting; but do not receive the Society's Reports without payment, for a supply of which they may pay a composition.

Of Members and Associates:

XIV.

That Members and Associates be proposed by a Member or Honorary Member, and elected by the Committee.

XV.

That the number of Members be limited to fifteen.

XVI.

That no one become a Member or Associate without either paying a composition of 10s., or bringing a note to the President signed by his Tutor to allow a charge of 2s. 6d. per Term to be made in his bill.

XVII.

That Members may speak at all Meetings of the Society; may read Papers with the leave of the President; may introduce four Visitors at all Public* Meetings, and receive a copy of the Society's Report.

XVIII.

That Associates have the same privileges as Members, except the right of voting at Private Business Meetings.

XIX.

That any Member who in the course of the year shall not have read a Paper before the Society, shall require re-election by the Committee.

XX.

That any Member or Associate may be suspended or expelled from the Society by a vote of two-thirds of the Members present, if he, from any misdemeanour, or want of energy, appear to deserve such suspension or expulsion: but such a motion cannot be proposed again during the same Term after it has once been voted upon in a Meeting at which four-fifths of the Members then in residence have been present.

Of Meetings:

XXI.

That Ordinary Meetings be held once a fortnight, but that the Secretary be empowered to call Extraordinary Meetings when necessary.

XXII.

That Visitors may speak and read Papers at all Public Meetings, with the leave of the President.

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* It having appeared that Members and Associates have introduced other persons not belonging to the Society into the Society's room, it is necessary to state that this practice is not permitted by the rules.

Of Reports:

XXIII.

That a Report be printed once a year, or oftener if the Committee think fit.

XXIV.

That an Editing Committee, of two Members and one Honorary Member, be appointed by the President for each Report.

Of New Rules:

XXV.

That, without notice given at the preceding Meeting, no change can be voted in these Rules, or any vote of Suspension or Expulsion passed.

XXVI.

That no change be made in these Rules, unless proposed by a Member or Honorary Member, and carried by the votes of two-thirds of the Members present.

XXVII.

That in all cases where one vote be wanting to make up a majority of two-thirds of the Members present, the President be allowed to vote.

PRIZES.

The Society gives a Prize (at present £2 to the first, and £1 if a second is adjudged) for an Essay on any subject connected with Natural History. The Prize is decided by a Committee of 2 Honorary and 2 Ordinary Members elected at the first meeting of the October Term. The Essays should be sent in to the President (anonymously) the second Saturday in the October Term, with a sealed envelope, containing the author's name. Preference is given to original work of any kind as compared with matter compiled from books or papers.

Former Winners of the Prize.

1871.	1.	H. Ricardo, on *Eyes and No Eyes.*
	2.	F. R. Hodgson, on *Pets.*
1872.	1.	L. Maxwell, on *Spectrum Analysis.*
	2.	H. N. Hutchinson, on *Motive Power.*
1873.	1.	Not awarded.
	2.	L. Knowles, on *Coal.* V. H. Veley, on *Cross Fertilization.*
1874.	1.	V. H. Veley, on *Symmetry in Flowers.*
1875.	1.	H. F. Newall, on *Impressions.*

LIST OF THE SOCIETY, LENT TERM, 1876.

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[In the Report Members are marked (M), Associates (A), Honorary Members (H), and Corresponding Members (C).]
Those marked (n) have become Associates by note: see rule 16.

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A. Ward (*n*)
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M. M. Adam
G. W. Harris
E. Bowden Smith
J. L. Teage
E. Hiron
C. H. W. King
J. C. Thornhill
Z. H. Nash (*n*)

LIST OF PERSONS AND SOCIETIES AND JOURNALS TO WHICH COPIES OF REPORT ARE SENT.

Those marked * exchange Reports with us.

The Headmaster
The Chairman of Governing Body
The Bishop of Exeter
Lord Dormer, Grove Park, Warwick
Professor H. J. S. Smith, Oxford
Professor Newton, Cambridge
Rev. J. W. Hayward, Flintham, Notts.
Rev. A. Bloxam, Harboro' Magna
Rev. A. H. Wratislaw, Bury
Rev. J. Robertson, Harrow
R. H. Scott, Esq., Meteorological Office
G. J. Symons, Esq., 62, Camden Square
W. Whitaker, Esq., F.G.S., 28, Museum Street, Ipswich.
Nature
Geological Magazine
Jermyn Street Museum
Astronomical Society, Burlington House, W.
Linnean Society
Geological Society, Burlington House, W.
Radcliffe Observer, Oxford
Oxford Union
Cambridge Union
*King Edward's School, Birmingham
*Clifton College, N.H.S.
*Marlborough " "
*Wellington " "
*Cheltenham " "
*Winchester " "
*Warwickshire " the Museum, Warwick
Leicester Philosophical Society
*Birmingham Society
*Bristol Naturalists' Society, Museum, Queen's Road, Bristol
College, Wellington, New Zealand

LIST OF PERIODICALS TAKEN BY THE SOCIETY,

AND KEPT IN THE SOCIETY'S ROOM.

Land and Water
The English Mechanic and World of Science
The Journal of Botany
The Entomologist
Science Gossip is kindly placed in the Society's Room by Rev. T. N. Hutchinson

LIST OF PAPERS.

Those marked * are by Members of the School.

REPORTS.

STATISTICS, &c.

MINUTES OF MEETINGS.

PRIVATE BUSINESS MEETINGS were held Jan. 30, Feb. 13, May 1, May 22, June 5, June 14, July 26, Oct. 9, Nov. 13.

MEETING HELD JAN. 30. (58 present.)

Exhibitions: Drawings of Mars, by J. M. Wilson: Rhynconellae, by E. J. Power (M): Stones from Switzerland, by H. L. Baggallay (A): Lava from Sierra Nevada, and Australian Boomerang, by W. B. Thornhill (A): two Gutta Percha Gods, by E. T. Wise (M).

The President then read a communication from the College, Wellington, New Zealand, asking to exchange Reports with us.

Papers: The Secretary read the following paper by W. Larden (C) on '*Optical Phenomena.*' [For the Figures, see Plate 8.]

'The following is an account of certain Optical Phenomena that are of common occurrence, but yet may not have attracted the notice of many.

'I. Curious action of shadows.

'The experiment may be tried thus. Choose some white wall or dry white road on a sunny summer day, and setting up a rounded piece of board, or getting some patient friend to act as one, stand beside it or him at some two or three yards from the wall, so that the two shadows are thrown side by side. (Fig. 1.) You will see two shadows nearly black, each surrounded by a lighter haze, diminishing in depth of shadow from the inside outwards.

'Now on moving the shadows together, you will observe the following appearance. When the hazy portions are approaching one another, a protuberance will begin to grow out of each shadow at the nearest parts, as though the shadows were stretching over to

shake hands. (Fig. 3.) These increase until ultimately they join and form a bridge across (as in Fig. 2).

'Now how is this protuberance to be explained? It struck me that *irradiation* must have something to do with it. A few words by the way on irradiation, as many will very likely not have very definite ideas about it. Irradiation is the apparent encroachment either of a light object over a dark background, or, as in this case, of a light background over a dark object. Now the amount of this depends on the relative intensity of the light with regard to the dark. Example: A white disc of paper on a black ground will appear larger than it is; or a white hot thin platinum wire against a dark ground will appear as thick as a common pencil. Again, a dark disc on a white ground will appear smaller than it is, owing to the encroachment of the white ground over it. This action is purely one in the eye alone. When a very bright image on the retina is setting a certain portion of it into violent vibration, while the image of the dark background (comparatively) leaves the neighbouring portions of the retina at rest; the vibrations are wont to extend somewhat over the edge of the real image; and the brain interprets this to the effect that the image, and so the object, is really larger than it is. So, to return to the point: the white background of the wall appears to encroach on the dark shadows on all sides equally, so that it is the true shape, but smaller than reality.

'Now for how much will this alone account? Obviously, we shall see, for the bridging over. For when any two parts of the shadow have touched, the white wall still appears above and below the place of juncture, and appears wider than it is; *so* leaving the joining isolated. (Fig. 2, and Fig. 2 *a*.)

'But how do we account for the growing out of the shadows to each other before contact? By bringing into consideration the hazy edge to each shadow, or the so-called *penumbra*. This is the region of partial eclipses of the sun, where the object does not cut off all, but only part, of the sun's light. When the penumbræ of the two shadows begin to overlap, obviously the light between them is here lessened, and consequently also the amount of irradiation. In consequence of this, the shadows, which, we have said, appear smaller than they are, because of irradiation, are in these portions restored more nearly to their real size, and hence appear to bulge out. (Fig. 3.) A somewhat similar appearance may be seen on holding your two fingers between your eye and the fire or the bright sky. You see a sort of bridge across.

'I am indebted to Mr. Seabroke for the suggestion of the *penumbra*.

'II. Apparent movements of external objects under certain conditions.

'Some of you may have noticed when sitting before the fire or a tea-table lighted with a lamp, your face buried in your hands, that the objects that you see through the chinks of your fingers appear to move about as you move your hands.

'I tried the experiment in various ways, with the following results:

'*First, Single movements.* To observe all these movements, I found the fire a good object; also things on a tea-table lighted by a lamp, especially a silver butter dish under the lamp, as having both light and shadow in it.

'Experiment: Gaze at a red hot coal in the fire, and gradually bring down your hand upon the field of view at about 4 inches from the eye. The other eye is shut. (The hand being out of focus will appear to have a misty edge.) When the misty edge of the hand begins to come across the coal, the coal begins to move up towards the hand. This is seen best when the hand is brought down on the field of view. When moved sideways the effect is less. When moved upwards, curiously enough, the effect is reversed, and the coal appears slightly raised, as by refraction in water.

'*Secondly, Double action.* Hold the hand 4 inches from the eye, and look through a chink at the fire. On moving the hand the coals appear to waver about curiously. The silver butter-dish before mentioned seemed to rock like a ship at sea. You get a very good effect by moving a piece of *perforated zinc* close to the eye. A bed of cabbages thus looked at seemed to lose their stability of character and vacillate very oddly.

'It struck me at first that it might be the warm air of the hand that caused the action, but I found anything would do instead of the hand. How this may be explained I do not know. It is obviously some action in the eye itself, both for other reasons and because the action is, as I said, reversed when the hand is moved up from below, and greatest when moved downwards; for no external action would be influenced by this.

'These are the two chief phenomena to which I wished to call your attention. There are, however, two other facts I might mention about the eye.

'III. It is generally stated that though each eye sees an object, the brain only takes it as one impression.

'Now this is only true when the two images fall on the exact back of each eye; and this can only be the case when we look directly at an object. (Fig. 4.) When we look beyond at something else, evidently the nearer object cannot now fall on the back of each eye. Consequently, as I have stated, we see it double.

'Experiment: Look at any object, and hold up a gold pencil somewhere between. You will see it double. If you look at the pencil, the further object is seen double. Anywhere will do to hold it, but it is difficult to see the double distinct unless the pencil is nearly between you and the object you are staring at.

'IV. Another curious thing about the eye is, that there is one blind place on each retina where the nerves go off in a bundle to the brain.

'This may easily be shown. On a piece of white paper make a blot. Then about 4 inches to one side make a cross; both

rather small. If you are going to use your *right* eye, the cross must be 4 inches to the *right*; if your *left*, 4 inches to the *left*. Now, close your left eye, and fix your right eye on the blot, the paper being held about 2 feet from your eye, the blot and the cross being in a horizontal line. You will be aware of the cross, though not looking directly at it. But, on moving up the paper, at about 10 inches off (if the cross and blot be about 4 inches apart), the cross suddenly disappears. Do not look after it, but move the paper on. It soon appears again.

'The reason is this. The blot you look at must necessarily throw its image at the back of the eye. The cross to the right will be imaged a short way to the left. (Fig. 5.) As the paper moves up, and the cross and blot subtend a larger angle at the eye, the image of the cross moves away to the left, and at a certain point passed over the blind spot. Fig. 6 is looking down on the eye from above. If the marks be further apart, obviously the disappearing distance will be greater.'

V. H. Veley (M) then read portions of his Essay (which obtained the Society's Prize) on '*the Symmetry of Flowers and Inflorescences*,' of which we give the following extracts. [For Figures, see Plate 9.]

'Regular flowers are mostly terminal and solitary, irregular mostly axillary; this is the first distinction between the two classes. Regular flowers have their corolla and calyx perfectly uniform, irregular flowers have their corolla bent into various shapes. For instance, let us first take the Papilionaceae or Pea family; in the instances mentioned above any imaginary line drawn through the supposed centre will divide the flower into two equal parts, but if we apply the rule to the Papilionaceae and draw any line, it is obvious that the upper part does not coincide with the lower, because in the lower there is one sepal and halves of two others, whereas in the upper there are two sepals and (Fig. 1) two halves. Then what line must we take? If we draw a line from the general stalk on which the flowers are disposed, *i.e.* in botanical language, the axis of inflorescence, to divide the subtending bract into two equal parts, the flower is also divided into two equal parts. A dot *a* represents the axis of inflorescence, *b* the bract. The division is so exact that the free stamen (in this family) is divided into two equal parts, and on one side are 2½ sepals, 2½ petals, 4 stamens, and 2 half stamens, one of which is the free stamen, the other the stamen exactly opposite. But of course such a fact requires an explanation, and the only one is this. In the early formation of the bud there were two forces pressing on each side, the force of the stalk on the upper side, the force of the bract on the lower, and of course if there were no bract the flower would be solitary, and therefore ten chances to one regular. It is exceedingly probable that pressure on both sides would cause an elongated-shaped corolla, as in the Labiate and Papilionaceae, in which the standard has escaped the pressure, but

the wings and the heel have been pressed. It is just as if a soft piece of metal were placed between two heavy weights which would squeeze the metal flat.

'It may be put forward that all flowers that are terminal are regular, the instances are exceedingly numerous—in fact, I am prepared to say in my slight knowledge that all terminal solitary flowers are regular, unless there is a certain force that acted upon it when in the bud. By regular, however, is meant a regularly shaped corolla and calyx, as the Buttercup or Hawthorn, whose stamens are irregular in their multiplication. A few instances might be mentioned. The Ranunculus genus is terminal and regular, the Larkspur is axillary and irregular; again, the perfect abnormal form of Linaria with five spurs regularly developed is generally terminal. How can this be reconcilable with the fact that the Convolvulus sepium (Greater Bindweed), which is naturally regular in its inflorescence, has been seen to be irregular when terminal? Possibly because the growth of the main stalk was stopped, and therefore an irregular pressure took place. The opposite to this often takes place, viz., a flower truly terminal thrown on one side by the growth of a branch on the other side, for instance, in the Chickweed and Vinea Minor or Major.*

'To return after my digression, let us take other families besides the Papilionaceae. In the Violet Family, if we draw such a line, the flower is again equally divided, but there is a difference in the division of the former and the latter; in the Papilionaceae the odd petal is posterior, in the Violaceae the odd sepal is posterior, which always happens except in the Papilionaceae when the number of the organs in a floral whorl is irregular (Fig. 2). The next irregular plant is the Fumaria Officinalis, sepals two, petals four, stamens six, united into two sets of three, the middle anther being larger than either of the side ones; again does the line drawn from the axis to the bract divide the flower into two equal parts, one petal anterior, one posterior and lateral, one sepal anterior, one posterior, all stamens lateral, and pistil divided (Fig. 3).

'But though the flowers are irregular, the development of the raceme is exceedingly regular; the flowers are disposed on the stalk in the same arrangement as 'the $\frac{3}{8}$ leaf arrangement,' *i.e.* the ninth flower is in exactly the same position as the first, and the flowers that are between accomplish three circuits (Figs. 4 and 5); this plant, as most plants, flowers in its inflorescence in a similar way to its arrangement of leaves. The raceme of Veronica Beccalunga (or Brook-lime) is the same.

'The next families of any importance noted for their irregularity are the Labiatae and Scrophularineae. The elongated form of their corolla seem to indicate pressure on both sides. All the instances I have mentioned, with the exception of Lamium album, flower in

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* An analogous growth to this occurs in the tendrils of the Grape-vine which are really the summits of the branches, but a branch from the axil of the uppermost leaf grows with so much vigour as to seem to be a continuation of that from which it proceeds.

an indefinite inflorescence; the flowers are disposed in a manner similar to their leaves, as in the Fumaria Officinalis, but the causes of irregularity are numerous, amongst which are, 1st, the development of bracts instead of flowers, 2nd, more than one flower appears at the axil of one leaf. Similar to the raceme is the corymb, in which the pedicils are lengthened so as to form one level top, and the next stage is the umbel, in which all the pedicils arise from the same apparent point, although in a few species a very slight elongation is visible, as for instance Pimpinella Saxifraga. The next and most important is the head. This is seen to best advantage in the Compositae. The corolla is irregular both in the ray and the strap florets, with no apparent bract: then what is the cause of the irregularity? The cause is the close pressure of a number of florets in so small a compass, and it will be seen in the Taraxicum Dens Leonis (or Dandelion) that the inner florets are gradually shorter than the outer ones, and those quite in the centre with numerous florets on each side are exceedingly small and sometimes scarcely developed.

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'The plant whose cyme is the most regular is perhaps Stellaria Holostea or media (Stitchwort or Chickweed). The difficulty is to find the leaf in whose axis the flower was formed. I believe it is not formed in the axis of that leaf in which it appears; for if a line (Fig. 6) is drawn from *c* to the bract *d*, we find the flower is not divided into two equal parts, but if we draw one either to *d* or *e*, which are at right angles to *a* and *b*, we find the flower is divided equally. Similarly it is found that the flower was formed in the leaf *b*, and the flower *g* is formed in the axil *d*, the leaf *g*. The irregularity of this genus Stellaria is this, instead of the normal number of stigmas there are only three placed, as in Fig. 7, and the line drawn from the axis of inflorescence to the leaf divides the flower equally. There are very small bracts a little way below the flowers, but they are too small to have made any material alteration to the development of the corolla—in fact, they appear after the flower has fully blown. Irregularities are common in this normal arrangement of cyme in Stellaria Holostea. Sometimes the bracts are multiplied to prevent the development of the flower, but even these supernumerary bracts are opposite each other in pairs, like ordinary leaves—a monstrosity which entirely changes the structure of the parts affected, not interfering in the least with the rule which determines the position of leaves and bracts. Sometimes one branch goes on developing while its corresponding branch on the other side stops, and sometimes—which is the most common irregularity—the branch goes on producing nothing but leaves, placed in their proper position, instead of flowers. (Fig. 8 represents a perfectly developed cyme of Stellaria Holostea, the corresponding flower marked with a corresponding number).

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'The variations from this type of Hypericum perforatum are

exceedingly numerous, though the variations of L. diurna and vespertina mentioned below are even more so, a perfect inflorescence being never found. There is another remarkable irregularity in the inflorescence of Hypericum pulchrum, which is this: one of the leaves in the axils of which the secondary branches spring is not developed in its proper position, but it is developed after the interval of an internode as one of the members of the calyx of the flower; this prevents the development of that branch in the axil of that leaf which developes in such an extraordinary position (vide Fig. 9). I do not know how many pages could be written on the subject of the Hypericum only: I have merely mentioned two irregularities, the former of which is very common, the latter rather rare.

'The next inflorescence is the perfect scorpoid cyme or one-sided raceme, that is to say, the flowers on the one side of the stem of a cyme are developed and not the other; the irregularity drawn in Fig. 9 is an alternate one-sided raceme (vide Fig. 10). It is a raceme because the lowest flowers first, it is a determinal because the primary axis is stopped by a flower. The inflorescence of the White and Red Lychnis is perhaps the most irregular of those that are distinctly cymes, I mean perfectly developed cymes. Mr. Bentham calls it "a panicle." Now panicle is a term in botany for an inflorescence which is never perfectly regular: it is a happy term that might mean anything. The model of the inflorescence of Lychnis is that of the perfect cyme described under Stellaria Holostea; however the varieties as usual are numerous, amongst which the most noticeable is the one drawn in Fig. 11, in which the highest of course flowers first, as is proper, and two axillary branches developing, but in the axils of the two under pairs of leaves on one side were developing axillary branches, the higher one being in a farther state of development than the lower, as usual. Again, in another specimen there were two axillary branches in the first pair of leaves without a central flower, and then a regular development (Fig. 12);—in fact, in this genus the varieties are numerous beyond calculation.

'But whatever nomenclature botanists are pleased to adopt in the plants that are mentioned above, they very prudently omit any name for the inflorescence of Myosotis, (Forget-me-not). Yes, they omit it prudently, because some people—and not unjustly—think that science is made for names, and not names for science. First, the inflorescence is *definite*, because the primary axis is stopped by a bud, and development takes place in the axillary branches. Secondly, it is a raceme, because in the axillary branches the lowest flowers first, and therefore the inflorescence is *indefinite*.* Thirdly, the raceme is *regular*, because the flowers are placed alternately, and so are the leaves. Fourthly, the raceme is *irregular*, because sometimes fully developed leaves appear in the middle of the raceme.

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* Again, it is indefinite because in some specimens the primary axis is not stopped.

Mr. Bentham describes it "as a one-sided raceme either forked or simple"; generally, I believe, forked, but can it be one-sided because the flowers are in Myosotis palustris placed alternately? I have mentioned in the beginning of the essay about the symmetry of irregular flowers being seen if we draw a line from the axis of inflorescence to the subtending bract:—where is the bract? There is one sometimes at the very commencement of an axillary raceme, sometimes there is not.

'But after all this "confusion worse confounded" I will describe a few specimens I got, as perhaps a few of the varieties past calculation. Fig. 13 represents the inflorescence of three specimens I obtained, which I believe to be the real model of the inflorescence. First, after an abundance of alternately disposed leaves, the primary axis is stopped by a flower and placed in the axil of two secondary branches that are not axillary, that is to say, they spring from the axil of no leaf, and the most irregular part of a regular model of the plant is this, that one would suppose that as the leaves are alternate, that is, with an internode between the racemes, they would have an internode between them, but they start from the same part like an umbel. The raceme then is regular in the model, that is to say, the flowers are disposed alternately in the raceme, according to the arrangement of leaves. (The calyx is persistent, and so the fruit is not represented in the lower flowers.)

'The next specimen was the same as the model, with this exception, that in the middle of the raceme on both sides were a pair of alternate leaves, and the two buds near those leaves were arranged in a small umbel (Fig. 14). In a fourth specimen the inflorescence resembled a cyme, but instead of the leaves being opposite, and the axillary branches opposite, the leaves were alternate and the axillary branches alternate too, as in Fig. 15, and the racemes regularly alternate.'

Mr. Kitchener made some favourable comments on this paper.

R. D. Oldham (M) read the report of the Geological Section, printed in our Report for 1874.*

MEETING HELD FEB. 13. (38 present.)

Exhibitions: Whitby Ammonite, by H. L. Baggallay (A): Brazilian beetles, by W. B. Thornhill (A): Cage woven over with wool and string by an African weaver-bird, by E. J. Power (M).

* Copies of this, and of several earlier Reports, can still be had, on application to the President.

Papers: The following paper was then read by H. F. Wilson (M), on '*Suggestions on Practical Entomology for Schools*.'

'I feel confident that a paper about collecting insects will be highly uninteresting to the majority of the Society, but I hope they will not mind a few minutes being devoted to the bughunters, who, as they include among their number the President of the R.S.N.H.S. himself, are without doubt an exceedingly select body. It is, I believe, generally known, and if not, it should be, that there is a collection of lepidoptera in the Society's room, and, considering all things, this is a very good one indeed. But its excellence is in great part due to the large number of insects which have been contributed by various friends, in various parts of the country; and many of the insects marked with a red R (for Rugby) are common species, the rarities, as must be with pain acknowledged, being very few and far between. Now it seems to me that a school collection should be, as far as possible, a representative collection of the neighbourhood, if it is to be of any value whatever, and the result of putting rare insects from other neighbourhoods into the cabinet naturally is, to prevent such exertions being made as might be, to catch the same insects within five miles of the school. Of course, there are many insects that do not occur here or anywhere else except in some very favoured locality, such as the Lulworth skipper in Dorsetshire, and these let us get by all means, but do not let us, without first hunting everywhere here, resort to Kent or Sussex for insects which we have got at our doors in Rugby.

'Now the object of this paper is to supply that deficiency, or at least to suggest a means of supplying that deficiency, which exists chiefly, I should say, among the Noctuæ and Geometræ. There are some people whose sole idea of collecting insects is to rush wildly about with a blue or green, or perhaps in some cases a white net, in the hope of entrapping the unsuspecting butterfly by day, or the confiding moth by night. Now of course this is all very well in its way, and may not produce sunstroke if not carried to excess, but it is by no means the only way in which insects can be caught, and the truth of the matter is, that insects caught flying about are, in the majority of instances, a good deal knocked about, and this especially applies to moths. It strikes me that all other methods are more or less neglected here, which is of course owing in great measure to our being unable to go out late enough for sugaring, &c. But there is still one way, and this is a very important one, which is possible, and which is almost entirely neglected—I mean the method of breeding the perfect insect, whether from the egg, the larva, or the chrysalis; and about these a word should be said.

'I do not mean to say much about the eggs of butterflies and moths, for, though some have succeeded in it, it is at best very unremunerative though troublesome work; but even here something might be done, especially with the eggs of the larger Hawkmoths.

'But it is with caterpillars that so little is done, although here

there is always plenty of occupation offered to any one: for caterpillars may be caught all day and all night too, if you look out sharp for them, whether they are eating, sleeping, taking their morning constitutional, or otherwise employing themselves, as only a caterpillar can. If a beating and a sweeping net (for long grass) be added to your own powers of vision, many more will be caught, which cling as tenaciously to their food as the proverbial drowning man does to the proverbial straw. But it is not my intention to go on discoursing about the catching of caterpillars, for any book on lepidoptera is sure to give much fuller and superior directions on the subject than I can. So suppose your caterpillar caught; the question at once arises, Where am I to keep him? "In my study," says the ardent but infatuated collector. His chance of existence in a study is, to say the least, a very precarious one, for a lexicon may put at any moment an untimely end to it. No, a study will not do for larva breeding, for they *must have* space, and that you cannot give them there, and they *must have* air, and they certainly won't get that under a sofa. The fact of the matter is, we, the bughunters of Rugby School, want a larva-cage, and a place to keep it in, accessible to all. I will give a few directions as to the construction of a cage, similar to one which I have used with great success for two years. It should be about a cubic yard in size, made with only a framework of wood, leaving the four sides open, which should be covered with wire-gauze or muslin. The bottom of the framework is closed up for about 6 inches to contain soil. On the floor should be a layer of small pebbles, to admit of drainage, upon which should be laid a stratum of soil, previously baked, to get rid of intruders such as slugs and earwigs, and about 4 inches deep. The top of the cage should be closed in by a sloping roof, where those caterpillars who are of a morose and ascetic turn may seclude themselves, and gaze in contempt on their more frivolous neighbours, and on which all pendulous chrysalises may change unmolested. The inside should be left unplaned to assist the perambulations of the prisoners, and one side, or part of it, should be used as a door, and then our cage is ready. Each member of the Entomological Section should undertake the charge of it for a week, and feed the inmates regularly. Food may be supplied either by small trees planted in the soil, or by boughs broken off and stuck in bottles of water. Every one then on finding a caterpillar would take it at once to the cage, instead of looking for a cardboard box, say 4 inches square, in which to stifle, if not to starve, his hapless victim. Here he would be safe, and have a better chance of existence, and here let us leave him.

'Again, as to chrysalises little need be said: every one knows that nothing but a trowel is needed to excavate at the trunks of trees, and to place them in your power. When caught they should be tenderly laid to rest upon a mixture of sawdust and soil, in a box with a muslin lid. Here they may rest in peace until they

think it time to transform, and then they walk up the sides of the box, purposely left unplaned to assist them, and dry their wings on the top. What follows we need not say: life is short at the best.

'I hope that somebody with more influence will take the matter up, and that before the spring we may be provided with a suitable cage. Till then, the cabinet must ask for Mr. Wratislaw's help, and that of many others as well, to supply the deficiencies which we might supply ourselves.'

The Reports of the Entomological Section and the Temple Observatory for 1874 were then read. These were printed in our Annual Report.

Mr. Wilson then announced that the second half of the Geological Model would be finished in a few days, when a cast would be taken of it in plaster of Paris.

MEETING HELD MARCH 6. (58 present.)

Exhibitions: Portions of a Roman *amphora*, with the potter's name impressed on the handle, found on the site of an old Roman station, near Daventry, by F. Willoughby (A): specimens of various Minerals, by Rev. T. N. Hutchinson.

Papers: Mr. Percy Smith (H) read a paper on the '*Chameleon Barometer*,' the principle of which he explained as follows:—

'Paper soaked in a solution of chloride of cobalt changes colour according to the amount of moisture in the air, being blue when dry and red when moist. With this preparation it is possible to detect a change in the moisture of the atmosphere, corresponding to a difference of half a degree as measured by the wet and dry thermometers. The differences are less appreciable in winter than in summer.'

He concluded by drawing a few hasty lines on paper, apparently with water: but the paper being warmed, a cleverly sketched figure appeared, of various colours.

The President then read the following paper on '*Owls*,' by an anonymous contributor: [See Plate 5, drawn by the writer.]

'Sir,

'May I be allowed, as a stranger who has had the privilege of being present at more than one of your meetings, to advert to several startling statements, embodied in a paper "On Owls," which was read in the hearing of this Society, by a Member of it, last term?

'It is desirable that these statements should be confronted by means of facts drawn from life, or the actual experience of an owlist. I derive my information from a lady friend who has kindly supplied me with a copy, illustrated, of her last work "One Owl Only, a Memoir." Under these circumstances I shall be forgiven for making rather copious extracts from a work which contains, I may securely say, a biography as faithful as any which has ever been brought before you.

'Before quoting, however, I must state, what I have ascertained by special inquiry, that the subject of these memoirs was a brown or tawny owl. Of course I am not going to deny that *barn* owls hate women and make their young ones hatch each other, but I can positively affirm that brown owls do neither.

'The memoir begins thus.

'"I had an owl, an infant, innocent owl. He was an orphan. His parents were poachers.' [The keeper himself admitted that he never knew an owl eat a pheasant, but 'they frighted them,'—so they were poachers, and died.] He was born in the year 1870. In April of that year he was, I presume, an egg, but in May he was laid a downy thorny handful in my lap. There was nothing to see but eyes as large as mill-wheels, nothing to feel but beak and claws, —and they were enough.

'"The keeper, who shot his parents, brought him to show me. I will say for the keeper that he had been taught by his masters to prefer pheasants to humanity, and that he was a nice, generous man to bring me the bird to see before he 'carried it home to his bairns,' for it was impracticable—impossible to part: the handful was consigned to me, claws and all. At the same time the rest of the brood, owlie's twin brothers, exactly like him, were bestowed in cottages close by. They were like him in all points except in the expression of the eye, (here a note says 'refer to portrait'). Owlie was very fond of them: they had been eggs together!" I must here break the narrative just to point out, that if in this case brothers hatched each other, they must have had considerable coil about it.

'"The first night he would eat nothing. I remember he slept in my room, and amused himself and me at midnight by struggling with a pile of hymn-books, which he knocked down with climbing upon. This was a sign of life which I welcomed with gratitude, not foreseeing how many future nights would be disturbed, cut up by his innocent owlish escapades. He was excessively surprised at me in the morning for carrying him downstairs to the room below, which became his nursery, and was called "the owl's room" from that time to this.

'"When we were getting really anxious about him, he opened his mouth and swallowed an entire young sparrow. He had a ghastly habit, as an infant, of rattling his beak at you when you fed him: but later in life if you brought him a bird, he accepted it in one claw. A mouse he would swallow slowly, letting the tail droop

gracefully from one side of his beak. A worm he hated ever since one day when he was given two or three to play with, and they ended by being swallowed and disagreeing with him.

'" His room was fitted up with a china-closet projecting from the wall, and crowned with a cornice convenient for him to sit upon. The top of the curtains was convenient for the day-time, being dark. The door likewise was covered by a cornice, for the cupboard ran into it at the top, and there was formed a castle-top as it were, perfect for the purpose. There, when owlie sat, he could command the door. It was his habit to do so, and surprise visitors by plumping down upon it as it swung open to admit them, with the brisk inquiry, 'Hoo-o?'—But I forestall. From the time he entered that abode a snapping, hungry youngster, to the time he left it by the window a full-plumed bird, was five months. He ran about at two months, and flew at three. [He flew at many more than three before he died—but this is not what I meant.] Good appetite, and a love of personal cleanliness were speedily developed. One morning when I came in from school, the household seemed to be excited, and going on I found them all assembled in the owl's room, supporting a frightened maid who had been set to scour the floor. She had been busy on her knees, when owlie, observing the water, and actuated by a cordial and friendly desire to help, came down on the edge of her pail. He was too sudden, as usual; the poor girl was seriously upset, and when I reached the spot owlie was in undisturbed possession of the pail, and was washing his feet with high delight, holding up his feathers that his legs might have full benefit from the suds, and prancing about the floor to dry his down stockings when he came out.

'" Dancing was his delight at this age, before the stockings changed for feathered pantaloons. Often and often have I and my brothers stayed up after twelve to see him perform. It was our candle that excited him, and how could we go away? He could do what is called 'setting to partners' in the lancers to perfection: and would ask me to waltz sometimes with much grace, and show me how to do it.

'"To visitors he was uniformly urbane, but he did not like men. I must say it was always their fault when they got flown at. For instance, one day he was called on by a clergyman of venerable appearance and bald head. Owlie was sitting on a chair-back, with his eye on the higher regions. It was after he was fledged for short flights. The clergyman knelt down to look at him too closely, and owlie making his head a 'take-off,' lodged lightly on it, and flew to the top of the cupboard. Similarly he once clutched the hair of a Rugby master who was repugnant to his taste, though exceedingly deferent and even reverent in behaviour. My brother was an exception, but then he was employed to get him birds. The cats would not do it. The little school-girls used to bring mice wrapped up in paper for 'Miss Charlotte's owl.' But that was when we were away, and reminds me of the curate. In August we had to

leave home, and a curate, a kind, timid man, was put in charge of the parish, house, and—thanks to his own kind offer—of the owl. I introduced him very carefully. Owlie showed no hostility, but I believe the poor man suffered terribly in his nerves, for he honourably insisted on inspecting the owl's room every morning, and when I came back owlie was very fierce and greedy, with a new-born screech, and the curate was gone! I believe he has a living now. My bird was never so tame again after that month. He was lost one day in the chimney, and when he came down we had to block it up, and soon, soon after.........but to return: for it is time the gentle side of the owl were brought forward, brightly as it is preserved in many tender memories. He was never known to be unkind to age—except in the one instance mentioned, where there was provocation:—one old gentleman visitor fairly worshipped him, and two bishops at different times asked to be admitted to his presence. But undoubtedly he was fondest of old women. One dear old person from the almshouse, I recollect, spent a whole morning in his room, sitting in a state of supreme delight and admiration. Owlie did several things for her. He ran up and down a slanting* pole across one end of the room, face-forwards, crossing his feet in front of him, like Blondin, not shuffling sideways like a canary. It was that day I took his portrait in six or eight different attitudes; one of them being taken at a moment when he discovered a moth on the ceiling,* and another nice one of him looking at his toes. At the foot of the page he signed his own name; I remember well, —he held the pencil, and I moved the paper.

' "One of his chief interests was observing moths, daddy-longlegses, or other living creatures of a nature too insignificant to be eaten: sometimes shadows were as engrossing: indeed, he studied the effects of light and shade with such intentness, that when the candle was brought in with his supper in the evening, he would attend exclusively to it, attack it with flaps of his soft wings, gyrate round it, and see nothing else till it was set down in a safe place.* He always assaulted a thing that he did not understand. Say, boots. Now he could *not* understand our boots. Why did they disappear, and reappear in that perplexing manner?—down he was on the floor, marching round and round a lady visitor, and if he found a foot, what fun! He would grasp my boot and hold it as if he feared it would go again. I find this entered in my diary of the time as 'Waltzing with Owlie.' It was rather like it.

' "An anecdote of his childhood comes in here to prove his partiality for females. An elderly lady was in our drawing-room one day, and wished to see him. He was carried in on a tray (he was too young to walk then) and set down on the table. His eyes were splendid even then. Of course she was captivated, still more when he suffered her to stroke his back and kiss him on the head. Later in the year she called again, and entreated to see him once

* See Plate 5.

more. She was admitted to an audience of the perfect bird. He wore his full plumage of rich grey and brown, dappled on the wings, downy on the cheeks, radiating round the orbicular eyes; he preserved the untroubled gaze of his youth with the added dignity of maturity. The genuine outburst of enthusiasm, natural in such a guest, gratified him so that there came a feather floating down, which she caught up and put into a special pocket of her purse." —What need to cite further passages in proof of the plain truth, that an owl loves those that love him, be they male or female? If any person has anything to say, let him now speak, or else for ever hereafter hold his peace.

'Yours, Sir, very faithfully,

'AN OWLIST.'

Mr. Seabroke (c) then explained and exhibited the *Sciopticon*, a new and improved form of magic-lantern, with which some striking effects were shewn on a screen. After several drawings had been exhibited, a solution of chloride of tin was decomposed by an electric current: and it was strange to see, magnified on the screen, a fern-like shape apparently growing out of nothing: the fact being that the tin, liberated from the transparent solution, collected at the negative pole of the battery.

MEETING HELD MARCH 20. (70 present.)

Exhibitions: Roman strigil, from Somersetshire, and spur of the time of Henry VI., from Coventry, by L. Knowles (M): List of flowering-dates of local plants, from 1868—1874, by F. E. Kitchener and H. W. Trott (M), (see Botanical Report).

Papers: Mr. Kitchener read a paper on '*Carnivorous Plants*,' describing the 'Venus fly-trap' and the 'Sun-dew,' and the various experiments that had been made with them.

H. F. Newall (M) then read a second paper on '*Drops*.' [The investigations into this subject were continued afterwards, and the results communicated in a series of papers, both by Mr. Newall and others: and the whole of these have been worked up by Mr. Newall into the following paper :—]

'The subject of "Drops" was opened, in the Society, first in December, 1874, and a paper on the subject will be found in our last Report, p. 38. An explanation offered by Mr. Wilson gave rise to a few experiments, of which the object was, to find out

whether the bottom of the drop, in falling, was indented by the resistance of the air: for Mr. Wilson proposed that the indentation might make the mark, (which Plate 3. Fig. i. shows).

'A drop of heated wax was let fall from the top of a house to the bottom into a pail of water, and the round globules thus formed were very slightly indented. But there are three possible explanations of this indentation: (i.) that it was the collision between the globule and the surface of the water; (ii.) that it was the resistance offered by the air; and (iii.) and most probably, that it was the contraction of the heated wax in cooling.

'A drop of heated wax was let fall on to a plate of *cold* glass. The wax on touching the plate immediately spread or "splashed," and cooled; and in the middle of the splash was a small bubble of air. And besides this another fact was noticed: that the outer rim of the splash was far thicker than the inner. (See Plate 3. Fig. iii., where a section and ground plan of the splash are given.) This was evidently caused by the rush of the melted wax outwards, and before it had time to get back again, and make the surface of the splash level, the wax cooled.

'A drop of heated wax was let fall on to a plate of *heated* glass. When the wax spread, it did not immediately cool: when however it had cooled, the surface was level, and the thick rim of the last experiment had disappeared. And in this experiment also another fact was noticed: that the little bubble of air, in the centre of the splash, burst; and the following explanation immediately suggested itself—that it was the bursting of this bubble which made the inner ring and dot: and in hopes of finding out whether the bursting of a bubble *would* make such a mark, resin was sprinkled over the surface of some water, and a bubble was blown from underneath. The bubble rose of course and burst, but no mark was visible. Lycopodium was also tried, but no more successfully.

'That it was not the bursting of the bubble that made the mark was proved by the following experiment. A drop of melted wax was let fall on to a piece of smoked glass, which had been allowed to cool, and though the bubble had not burst, still the mark was there, as perfectly defined as ever.

'At the advice of Mr. Wilson, the experiment of letting fall drops of liquid on to smoked glass *in vacuo* was tried. Mr. Percy Smith kindly provided me means of performing this experiment. Drops were let fall, and the marks made were examined, and found to be not nearly so clearly defined as those formed under ordinary circumstances. The inner ring and dot were confused, and had blended into one large dot. (Fig. i. shows the ordinary mark; Fig. ii. the mark formed *in vacuo*.) This experiment, however, is hardly to be relied upon, as the apparatus was scarcely perfect, and only three drops were let fall. If, however, we may at all trust to the results, we are led to believe that it is not the resistance of the air, or rather the indentation caused by it, that makes the mark.

'An explanation offered by Mr. Seabroke gave rise to the

following experiments, which gave some very curious and puzzling results. Mr. Seabroke's explanation was, I believe, as follows:—The drop was not indented by the resistance of the air, but on touching the plate of smoked glass, it fixed on to it a small round dot of black, whilst the rest of the drop rushed on and washed down. Then the point which had first touched was repelled into the drop. By this the bottom of the drop was rendered concave. The drop, or rather part of the drop, then rebounded and fell again on to the smoke, and thus the rim of the concavity fixed on to the glass a ring of black. Of course all these stages are instantaneous. Now let us consider this explanation. First, the drop falls and fixes on to the glass a dot of black. Then the rest of the drop washes down, whilst the inner part of it rebounds and falls on to the glass. But surely there is a slight slip here. For would not the drop when it washed down wash away all the black except the little dot at first fixed on to the glass? and then, granting this, where is the black for the rim of the concavity to fix? Again, the outer and lighter ring is not accounted for; and surely there cannot be a second rebound.

'But, in order that the point which rebounds should fall again on to the same spot, it is necessary that the plate should be horizontal, and consequently, if the plate be placed at an angle to the horizon, the point which rebounds will not fall on to the same spot, but a little lower down the plate. So I placed the plate at an angle of at least 45° to the horizon, and then let fall a drop from a height of about 6 feet, and got the result which Plate 3, Fig. iv. roughly shows. Two more exact drawings of the inner dots thus formed are shown in Plate 3, Figs. vi. and vii. They are enormously magnified; by means of a very rough form of magic lantern the marks on the glass were thrown on to paper, and drawn in outline and then filled in from the original marks magnified with a microscope. Figs. vi. and vii. were drawn from these drawings.

'The results obtained in this experiment seem to show that rebound as a means of producing the mark is impossible.

'But by this experiment another difficulty has been added to the subject. The elliptical dot which ought to have its major axis in a vertical position (as shown in Plate 3, Fig. v.) has in reality its *minor* axis in that position, thus seeming to violate an important rule.

'Another explanation suggests itself, arising from the experiment of letting fall a drop of heated wax on to a cool plate of glass. There, it will be remembered, the outward rush of wax was cooled before it could get back. So could it be supposed that it was the return wave of this outward rush that produced the rings and dot? But this may be instantly disproved by letting a drop of heated wax fall on to a piece of smoked glass, previously allowed to cool. Then we find that the mark is clearly defined, though there can have been no return wave, for it remains in a heap, so to speak, all round, having been cooled before it could get back. Again, the

"return wave theory" may be disproved by the experiment of the inclined plate.

'The following facts noticed, and explanation suggested, by Mr. Worthington, were communicated to the Society.

'The smoked surface is not wetted by water. There is an apparent repulsion between the molecules of the lamp-black and the drop, which will not readily be broken on the surface (if dropped from only a small elevation, say 2 inches), but rolls over the surface retaining more or less its spherical form.

'The drops, when let fall from a height of more than a foot, rebounded in part. Small portions detached themselves, in rebound, from the drop, and falling again left their own minute ring and dot as a satellite to the main splash.

'In the experiment of the inclined plate, it was noticed that the major axis of the elliptical dot was inclined at an angle to the normal to the plate, and the vertical. This inclination is probably due to the drop having a lateral spin on it.

'The lamp-black seemed to be piled up in the central dot, which had often a depression in the middle.

'The suggestion which Mr. Worthington offers is as follows:

'The drop rebounds, or, more correctly speaking, *part* of it rebounds. As every physical action takes time to perform, there will be different stages in the rebound and formation of the splash. Let us try and follow them. Suppose the drop to be spherical, and to have no appreciable lateral "spin." Plate 3, Fig. ix. shows a section of the glass plate and the sphere through the point of contact. A is the point which first touches, BB and CC are other points upon the surface of the drop. Plate 3, Figs. x. and xi. show the next stages, when the point A is repelled into the drop, drawing up BB and CC with it. And to this drawing up or lateral sweep of the points BB, CC, the outer lighter ring may be attributed. Then in the rising of the point A, there comes a time when it reaches the topmost surface of the drop, and when it does reach it the sides of the drop are thrown over, and falling down, wash away the lamp-black from the inside outwards. Thus, first we have the lateral sweep of ABC from outside inwards, then the washing away caused by the fall of the sides of the drop from inside outwards: hence just between the place of these two actions there will be a line where the sweeping away is neither way: the surface will be left unswept: this is the place of the black ring.

'The case of the inclined plane may be explained in a somewhat similar manner. (See Plate 3, Fig. xii.)

'Since Mr. Worthington's paper, he and myself, dissatisfied still with the explanations hitherto offered, continued the experiments together, and short accounts of them were communicated to the Society.

'We found that, on letting fall a drop of oil on to a piece of smoked glass from a very small height, of about 3 or 4 inches, and after waiting for a short time, during which we noticed that the

mark slightly altered, the mark finally assumed the appearance of the drawing shown in Fig. viii. But the stages and alterations were very noticeable. At first there was the line free from black, at the outside. But this line almost instantly disappeared, and then gradually opened again. This disappearance of the line I found out, after a rather long and close microscopic inspection of a good many marks, to be due to the following fact. First, the drop splashes making a mark of about ⅜ inch in diameter, and the oil, when it comes to this limit, (which is set by the property of the liquid called cohesion), seems to get under the coating of black, and just raise it up so that one can see a line of white. Then the "return wave" sets in, and so the part of the coating is let down again, shutting up the little gap which seemed white. Then there is formed a mound of oil, so to speak, and this mound is too high for the diameter of the wetted surface, and so there must be a second return wave outwards. That this is the case was proved also by means of the microscope: for I saw little specks of black float on the surface of the oil, first inwards till they met the wave from the other sides, and then outwards. This second outward wave then lifted up the coating outside again, and washed part of it away as it spread over the plate. And so the ring of white was rendered permanent.

'These changes I was enabled to make easily seen by changing the horizontal rays of a lantern into a vertical direction, by means of a mirror. Thus the mark could be observed the moment it touched the plate, and *all* the changes could be seen: whereas with a microscope, one has first to let the drop fall, and then set the microscope over the mark, and so the first changes are lost. The speckled appearance of the inside of the mark (Plate 3, Fig. viii.) seems to be due to the presence of a great number of air bubbles, which are pressed against the black by the falling drop. The inner ring seems to be composed of a lot of such bubbles arranged in order round the inner dot, which sometimes has a speck of white in its centre, *i.e.*, a speck of black has been removed from its centre.

'We used various liquids, but most often oil. Mercury and chloroform make really beautiful marks; and the lovely fern-like appearance of the radiations from the central rings and dots made by the latter would form a very beautiful and inexpensive microscopic slide.'

H. Vicars (M) read a lively paper on '*Owls*,' in reply to some statements in the paper read before the Society at the meeting of March 6.

The President then presented Mr. Kitchener, in the name of the Society, with a copy of Sowerby's English Botany, and Mr. Kitchener bade farewell to the Society.

MEETING HELD MAY 8. (56 present.)

Donations: Three volumes of 'Gray's Molluscous Animals,' with beautifully executed illustrations, presented by Mrs. Gray.

Exhibitions: Insects from the Black Forest, by A. J. Solly (M): Iron ore from Bilboa: Sketches of sun spots (April 7); and compound pendulum curves drawn with a needle on glass coated with lamp-black, the glass being then coated with collodion, and the plate thus protected used like a photographic negative. These sketches and curves were exhibited by H. F. Newall (M), who also shewed some photographs printed in this way from the glass.

Papers: Mr. Tupper (H) read the following paper on the '*Radiometer*':—

'Four very minute spokes of straw or glass, each bearing at its end a little pith disc, black on one side and white on the other, are made capable of turning on a delicate axle; so that the black face of each disc will in turn be presented to the sun. The machine is *in vacuo*. It rotates when the light strikes the blackened side of the disc, but not when the light strikes the white side.

'Explanation, on the received hypotheses of light, the conversion of forces, &c. &c.

'1st. The sun, or any primary radiant, may be defined as an agent whose special function is to excite into undulation the surrounding luminiferous ether.

'2nd. The luminiferous ether in undulation is *light.*

'3rd. This undulation is a special development of *force.*

'4th. All forces, vital, electric, chemic, calorific, photogenic, &c., are *non-evanescent* and *convertible.*

'5th. All forces develope themselves in the direction of *least resistance.*

'Now as black "absorbs" light, or (by the received theory) is an agent which when attacked by the undulating luminiferous ether, causes the undulation to cease, while white causes this undulation to continue in an opposite direction; let us suppose the undulation thus terminated by the contact of black, and the force which originnated it will have to be converted into a new form (an allotrope), possibly giving birth to electricity, heat, locomotion, &c., according as the assuming of one or other of these forms shall be attended by least resistance (as an electric current of one tension *ignites* a heap of gunpowder, while a current of a higher tension *displaces* the same heap without ignition).

'Then in order to convert the force of the extinguished undulation into a given form, say that of locomotion, we have to remove the resistances to locomotion, auch as air, friction, &c.

'So far, then, the reported results should be *a priori* expected. Let us now examine in detail: and, first, in regard to the white side of the disc.

'It encounters undulating luminiferous ether, and, in virtue of its special function (as whiteness) changes the direction of the undulation: but since it does not "absorb" light, the force is not imparted to the white substance. Neither is this as the case of a rebounding missive or projectile, for light is not an emanation, but an undulation. Still it may fairly be argued that the white substance would be in some way affected, just as the surface of a wall may be indented or its molecules intrinsically disturbed by the impact of a projectile: only it must be observed that while these effects are ever at the expense of the reverberation, and, so far as they exist, are the exponents of an imperfect reverberation, it would be begging the question to assume that any amount of fixity in the white object would return the undulations more completely. But even should we grant the possibility of some diversion of light-force into another channel, the fact still remains, which is sufficient for the occasion, that the light-force is not obviously liberated, while it as certainly continues active in supporting the undulations. Whereas, if we regard the blackened disc, the undulations, as soon as they reach the surface, cease to exist; their parent light-force is at once liberated, and ready to discharge itself in any other form consistently with a minimum resistance.

'Now what are the resistances that, as if by design, have been reduced to a minimum?—That of gravity, for the machinery is as light as "gossamer"; that of friction, for the pivot is of the utmost delicacy; that of atmosphere, for the whole is *in vacuo*.

'But these minima resistances are the resistances to locomotion, and it has already been shown how electricity, so nearly allied to light, will take upon itself the form of locomotion; whilst it is obvious (according to received laws) that perhaps all forces, but for resistance, would discharge themselves in the form of locomotion preferentially. The conditions of the experiment are then adapted to the result locomotion.

'Furthermore, blackness "attracts" heat, *i.e.* stops the undulation of the calorific ray. This additional force then has to be converted, and we find accordingly an additional force given to the machine when the heat-ray is no longer excluded by alum. Hence the disc should exhibit a lower temperature in motion than at rest. This should be tested.

'As a further generalization it is to be remarked that the machine acquires an access of energy under the influence of yellow and red, the "hot" colours, which it loses when propelled by the cold colours, green and blue. These latter stimulate the retina much less energetically than the former. Now the sight-process (so far as it is material) is nothing but a conversion of forces: that force which undulated the luminiferous ether discharging itself upon the neurine and evoking mechanical motion in its molecules, or, as it is more

recently affirmed by Donders, in the rods and bulbs of the retina. So that we have, both in this machine and in the eye, a delicate mechanical motion excited by the agency of light and the energy of this motion in both cases increased by light of certain colours.'

The Rev. T. N. Hutchinson gave an account of Mr. Crookes' earlier experiments. A short discussion followed.

H. N. Hutchinson (M) read the following paper on '*The Effects produced by Shadows under Water*':—[See Plate 2]

'One day, when standing by a clear shallow stream, with the sun shining brightly overhead, my curiosity was aroused by seeing a number of round shadows moving along the bottom. On looking at the surface, expecting to find a similar number of round objects, I saw nothing but a swarm of water-flies, known as the "Gerris lacustris." These flies have four long and two short legs, and propel themselves along the surface of the water by striking out vigorously at intervals. I then saw that these round shadows followed the movements of the flies and went in groups of six.

'Figure i. A (not in the plate) shows the fly itself, B its shadow at the bottom of the brook. The dark round discs are all produced by those parts of the fly which touch the surface of the water; the 4 large ones by the extremities of the four long legs, and the 2 smaller ones in front by the two smaller legs.

'Anyone who looks into a shallow stream on a bright day may see numerous other round shadows, and also bright spots produced by causes which will be explained further on.

'I did not at the time make any further inquiry into the subject, but as a favourable opportunity occurred last summer holidays, I made a few experiments, beginning as follows.

'*Experiment*:—A smooth, dry, wood pencil was held over water in a flat dish while the sun was shining overhead, and advanced towards the surface until the point just touched the surface.

'*Observation*:—The shadow of the pencil was seen at the bottom undistorted until the point touched the surface, when there appeared at the end of the pencil's shadow a small bright star. Fig. ii. A shows how the pencil was placed, and B shows the star at the end of the shadow. On the edges were seen prismatic colours, the blue being on the sides *a. d.* and *d. b.* nearest the sun, the red on the other two sides.

'This bright star seemed to be produced by four intersecting curves, two of which were plainly visible beyond the point *d.* The other two at *c.* are just visible on closer observation. If the background were darker at *a.*, *b.* and *d.* would no doubt be seen.

'*Inference*:—From this experiment we get the following result. Any point which touches the surface of water, causing it to rise up to it, produces on the shadow of the object below a small bright star.

'Thus on looking into streams I have often seen at the bottom

similar stars produced by floating objects, which, instead of making depressions, like the end of the water-flies' legs, draw the water up to them.

'*Experiment*:—This having been noticed, the pencil was pushed into the water some little way.

'*Observation*:—The water round the pencil was depressed, forming a visible depression, the result of which was that the star vanished, and the part of the pencil beneath the surface cast an ordinary shadow, but the part at the surface where the depression was situated, gave an almost round shadow, as shewn in Fig. iii. A and B. This shadow seemed to alter in shape according to that of the depression caused by the pencil. On each side were seen prismatic colours, with the same arrangement as before. As the pencil was pushed further *down* into the water, the black disc travelled *up* the shadow of the pencil, until when the pencil was wholly immersed, it disappeared and an ordinary shadow was seen as when it was wholly above the surface.

'*Inference*:—It would seem that the black disc is produced by the depression formed round the pencil, owing to the want of adhesion between the pencil and the water.

'If this be true, then any similar depression ought to produce a similar round shadow.

'*Experiment*:—Accordingly I took a glass tube, held it vertically over a dish of water, while the sun was shining, and blew down it.

'*Observation*:—A circular depression was produced and a black disc appeared, similar in all respects to that in Fig. iii. B. This is shown in Fig. iv. A and B (not in the plate). On blowing harder concentric rings of light were sent off from it. On blowing sideways, I got an oval with a bright spot on the part furthest from the tube, also a very pretty ring round the whole. This is owing to rippling of the surface, for a convex surface would converge the rays of light, forming a bright line underneath. Here is the cause of those beautiful variations of light and shade seen at the bottom of shallow water when its surface is rippled and there is a bright sun above.

'If the tube is not placed rather close to the surface the disc becomes indistinct, because the depression is less well defined.

'The shape of the black spot varies with that of the depression, as may be noticed in Fig. i. (not in the plate), where the lower shadows, those produced by the hind-legs, are rather pulled out, because the depression produced by the end of the leg is itself pulled out. In every stream there are numerous little eddies, seen at the surface as small depressions. On a fine day, if the stream is shallow, these may be seen to produce round shadows at the bottom.

'It seems clear that these are produced by the spreading out of the sun's rays when they fall on to the concave surface of the water—in fact, the action seems similar to that of a plano-concave lens.

'Fig. v. (not in the plate) is the result of working out the path of each refracted ray (taking $\mu = \frac{4}{3}$). This shows that, with the

water 3 inches deep, the rays falling on to the hollow surface A. B. would occupy at the bottom a space about twice as broad. Hence the darkness.

'With deep water these shadows become invisible, because the rays are so much more spread out.

'*Experiment*:—The pencil (Fig. iii. A.) was then raised until some part of it was above water.

'Directly it appeared above water a star was seen on its shadow below, (Fig. vi. A. and B.), and on pushing it still further out the star ran down the shadow, just as the black disc in Fig. iii. ran up the pencil's shadow.

'*Inference*:—The pencil, having been under water in the preceding experiment, was wet, hence on its emerging adhesion was produced between the water and the pencil: the water was consequently raised, and, as we should infer from the 'result' of the first experiment, the star was produced (as seen in Fig. vi.)

'By inclining the pencil into different positions in the water, the star was twisted into different shapes, in which much more of it could be seen, as in Figs. vi. viii. ix. (not in the plate).

'In Fig. ix. the two halves of the star are separated by a much longer space than in the three preceding figures, because the angle of inclination being much less, the length of water lifted up is much greater. In fact, this determines the distance between the two parts. Endless drawings might be made showing the effects of different inclinations of the pencil, but perhaps these four will suffice for our purpose. Nor is it easy to represent the effects by ordinary drawings. In those before us, dark lines in several cases represent bright ones.

'Let us now see if by any arrangement we can see more of the curves producing the star. What is required is, as we said before, a darker background.

'*Experiment*:—Accordingly I cast a shadow close to that of the pencil, as shown in Fig. x. A. This gave a dark background: the desired effect was produced, and the effect shown in Fig. x. B. was seen. This curve, (which one cannot help remarking is exceedingly like a "caustic,") is one half of our star, the other being hidden. Towards the end it gradually shades off.

'I noticed that as the shadow of my finger approached that of the pencil, it became peaked in the middle, as shown in Fig. xi. (not in the plate). This distortion must be due to the rise of the water round the pencil. By noticing when the distortion began, I could roughly find where the water began to rise. ¼ inch from the pencil seemed to be the limit. As the shadow got very near, its peak rushed to that of the nearer half of the star, which then disappeared, leaving the other half as in Fig. x. Just before it is obliterated a small round shadow is seen inside, which gets larger until it obliterates it.

'By means of a lens I got a magnified image of the curve taken by the water round the pencil, which I traced on paper.

'Mr. Wilson afterwards told me that it has been proved by calculation to be a hyperbola.

'*Bubbles* :—In performing experiments with water I often accidentally made bubbles on the surface, and in most cases I saw either a shadow or a rather large star. But they were so short-lived that I found it very hard to draw any of these effects. So I made some soap solution, such as is used for blowing bubbles, and with this I got them to last longer, but the water was not quite so clear as before, which made the effects a little less clearly defined.

'I found three classes of effects.

'(1) The first were small heart-shaped shadows produced by the very small bubbles of about $\frac{1}{8}$ inch in diameter, as shown in Fig. xii. 1. The curve of the upper part seems like the dark shadow bounding a caustic.

'(2) The second were larger ones of about half an inch diameter, which gave a large star, like the middle one of the Figure (xii, 2).

'(3) The third were larger still, and showed two shadows joined together and a large star between them (xii, 3).

'With those that were larger still I could see *no* effect.

'Now it is easy to see that the case of the bubbles is the same as that of the pencil in Figures ii. and vi. The bubble attracts some water round its base, which it raises up in the same way as the wet pencil did. So then these two phenomena are really the same. But the heart-shaped shadows produced by the very small bubbles are puzzling.

'I also noticed something of a rather different kind. In looking down on a bubble as it floated on the water, I saw three images of the sun: one on the furthest edge, another, a virtual image inside, and another on the edge nearest.

'*Another way of producing the same star* :—Probably many have noticed the effect produced by the sun's rays shining through a pane of glass, with a round lump in it, on to a wall. Such pieces of glass are often seen in factory windows. Now it was not until a few days ago that I found out that these effects are very closely connected with the subject of my paper. I happened first to see them upon a wall that was almost at right angles to the piece of glass, and even then thought I saw a faint resemblance to my star. So I took a piece of paper and held it parallel to the glass and rather nearer to it, and at once saw a star very like that produced by the pencil touching the water in Figures ii. or vi.

'One side of this lump is broken off flat, while the other is somewhat convex, so that it is a rough plano-convex lens. In my case the convex side was towards the sun, which was some way up in the sky, so that it shone through the edge of it. As things stood then, there did not seem to be sufficient similarity between this piece of glass and the pencil touching the surface of the water to account for such similarity of effects. But I put a circle of paper over the round lump, so as to allow the light to shine *only* through its *edges*. This paper then represented the pencil, and the rising glass round it represented the rising water pulled up by cohesion.

'I also got the same star by reflection from the flat side of the round lump. I tried with other similar pieces of glass and could not get it again, but these were not nearly so smooth on their flat side, which perhaps accounted for the fact.

'A reflection from the round side gives a series of caustics.

'Further experiments might probably bring to light some more results, unless the subject has already been investigated. A few such as the above can hardly be said to do justice to it. No one who tries the experiments for himself can fail to be struck by the beauty of the results produced. Any light thrown on the subject, or any more results, will be most acceptable.'

MEETING HELD MAY 22. (48 present.)

Donations: Two sea-birds' eggs, from Land's End, by the President.

Exhibitions: Glaciated stone, found in digging a well in the Bilton Road, by Mr. Boughton Leigh: Sketch of a whirlwind of dust about 25 feet high, seen near Coombe Abbey, March 16, by Mr. Percy Smith (H): Two grass snakes, one caught near Rugby, by A. C. Chapman.

Papers: H. F. Newall (M) then read another paper on '*Drops*,' the substance of which has already appeared, see p. 15.

The Rev. T. N. Hutchinson explained, with models, the principle of the pendulum, describing the method of determining the length of the seconds' pendulum, on which depends the length of the imperial standard yard, as defined by Act of Parliament, 1824.

MEETING HELD JUNE 5. (36 present.)

Donations: Drawing of the Lower Hillmorton sandpits, by G. W. Carleton (A).

Exhibitions: Rare dragon-fly, from Barby Road, by H. N. Hutchinson (M): Newly-born cray-fish, by C. Bayley (M): 3 new local flowers, by H. W. Trott (M): Tulip with irregular leaves, by Mr. Gillson (H): Remarkable daisy, the outer leaves having developed into fresh daisies, by G. M. Seabroke (C).

Papers: W. B. Thornhill (A) then read the following paper on *'Macaws,'* illustrated by two living specimens from the Amazon river:—

'As papers have been read already on Owls and their habits, I thought I would write a few words on the two Macaws here. I am afraid I have not much to say. I expect the birds themselves will be the most interesting. This one (the red) is much quieter than the other one, perhaps on account of their age. This one is above 30 years old, and the other about 8—I mean they have been that time caught; I don't know how old they were before they were caught. They have only been in England seven years, and were brought from the Amazon river in South America. Unfortunately, they will not talk or perform in any way before strangers, but only when they are by themselves in trees; then they talk, and ask you who you are, and where you came from—so they will seem very stupid now. They are not on very amicable terms with each other, and are very jealous when one is attended to more than another; but their characters are different too, for if you scold this one (red) it will try to make friends with you, while the other one will get into a frightful rage and try to bite you, which they can do very well, I find. But the red one never forgets the scolding, coming on to your hand in the most loving manner possible, and then biting you. They are very cunning and good when they can get any good by it, but when they are climbing trees they are not at all sharp, for they get on the highest and thinnest branch, and then bite it through on the side nearest the tree, so that when it is through they naturally fall down, branch and all.

'They always like having a swing when they get on trees, for if the branch does not swing at first, they make it by jumping on it, and then they begin screeching with delight when it does. But I can't see what good they can get by making themselves fall by biting the branch in two.

'The red one had a fit last week, and everybody thought it could not live; but by pouring alternately castor oil and brandy down its throat it revived, but it is not near so lively as it was.

'Their food is either bread and milk, Indian corn, hempseed or rice, and plain bread; but they must not get anything sweet or buttery, for that makes them very ill. Before they go to bed they get down from their perch, and pick up a stone and sharpen their bills, and make a horrible sound with it, like a pencil being rubbed wrong way on a slate. They can keep beautiful time dancing if you play a tune for them. These can be passed round if the Society like, but I won't guarantee them not biting.'

The President then read a paper by Rev. A. Bloxam, containing lists of local shells, and geological remains of animals now extinct. These lists will be found at the end of our Report.

Another paper on '*Drops*' by A. M. Worthington was then read; see page 15, where Mr. Newall has given his results.

MEETING HELD JUNE 26. (50 present.)

Exhibitions: An electric tinder box, consisting of a small battery and a lamp; a spring is touched which completes the circuit, and thus the lamp is lit; by the Rev. T. N. Hutchinson: A boar's tusk, among Roman remains, from Cave's Inn, near Watling Street, by L. Knowles (M).

The President then read a gratifying review of our Report of 1874, in 'Nature.'

Papers: A. J. Solly (M) read a paper on '*Silkworms*,' from personal observation of their habits. The paper was illustrated by specimens of moths and silk.

J. H. Jenkins (O.R.) read an interesting paper on '*Palestine*.' The chief point of the paper was a description of the author's researches in a tomb at Bethel. With the aid of natives, a rockhewn tomb 18 feet long by 17 broad, and 4 feet high, was excavated, and it was found to consist of five chambers, three of which contained skeletons, pottery, &c. He then presented to the Society some photographs, and a collection of wild flowers made by himself in Palestine. He also exhibited two phylacteries.

R. D. Oldham (M) then read a short paper on '*Drops*,' giving an account of further experiments. A short discussion followed.

MEETING HELD JULY 10. (24 present).

In the absence of the President, Mr. Kitchener took the chair.

Exhibitions: Two hippocampi from Venice, by Mr. Kitchener; Part of a wasp's nest found hanging from a martin's, by G. M. Seabroke (C); List of appearances of Lepidoptera in June and July, by H. F. Wilson and others (see Entomological Report); Marlborough N. H. Reports for 1874, by the President; objects of interest from India and Japan, by Colonel Carleton (H).

Papers: Mr. Kitchener then read the following letter he wrote from Switzerland about '*Carnivorous Plants*':

'Hotel Roseg, Pontresina, Switzerland, June, 1875.

'Dear Mr. President,

'Thank you for the weighty and worthy N.H.S. Report, which it was very jolly to get out here.

'Will you tell the Society that I have been examining the Butterworts, both the common English kind, Pinguicula vulgaris, and also the white one, Pinguicula alpina. I find their leaves covered with small midges caught thereon, by the viscous fluid distilled by small hairs ending in a globular gland.

'I notice that the midvein of the leaf is not sticky, and that it and the adjacent parts do not catch insects, while the most dangerous tracts are the parts midway between the midvein and the edges.

'The edges of the leaves curl over, and so make the escape of a struggling insect more difficult. I have found as many as eight or nine *small* flies on one leaf, and found the average of some half dozen leaves to be three or four. I have found one gnat entrapped, and one very large ant. I have caught ants and tried to impale or rather agglutinate them, but they wriggle out with some difficulty and with every sign of knowing that their escape depends on their agility.

'I have not been able to get any Sundews here, to make any experiments upon.

'The flowers here are splendid; the primulas gorgeous; I have never been in time to see them before. A bright red lily six inches in diameter of corolla was a somewhat startling phenomenon, as we came over the Maloia Pass out of Italy.

'On my way, by the bye, I caught an Apollo with my hand out of the window of a diligence-coupé; such was the sauntering impertinence of its flight. I guess he tasted nasty to the birds, or he would never be so lazy. Some small butterflies with green underwings frequent the larches, and are a splendid instance of protective mimicry. Do you know what they are?*

'Yours, corresponding member,
'F. E. K.'

Also a letter from Mr. Wilsòn on some bones found near Lawford; and a report on the same by Professor Boyd Dawkins; see Geological Report, and a plan of the exact spot where they were found, on Plate 6.

C. Bayley (M) read the following paper on '*The Little Bittern,*' exhibiting the remains of a local specimen, shot by a farmer near Rugby:

'A specimen of this bird was, unfortunately for it, about a month

* Doubtless *Thecla Rubi.* Ed.

ago observed at Lilbourne, about six miles from here, by a farmer, who however took no notice of it for some days, but at last he got out his gun, and having charged it apparently very heavily, stalked the bird, which he did his best to annihilate, and to all appearance very nearly succeeded in doing so—that is to say, he blew off the back of its head, the greater part of the breast-bone, broke one of the wings in two places, one of the legs in four and the other in two, and blew off the greater part of its toes, and what were not blown off were mostly broken and rendered it an extremely mournful spectacle. It must however have been put out of its misery pretty quickly, and probably did not suffer much. The remains of this bird were given to Mr. Sidgwick, who asked H. F. Wilson and myself to cure the pieces if it were possible, which we have done our best to do; but it was so mangled as to render it impossible to make anything but a poor job of it at the best. This bird is rare in Great Britain: only 27 specimens being on record, these extending over a period of 70 years. It is a native of Southern Europe and Northern Africa, where it is common. It has shot as far north as Sweden, yet this has occurred but rarely. In habits it resembles the other waders. It, like them, frequents swamps and marshes, and seldom flourishes far from the water. It however is very easily tamed, when it becomes very docile. It is able to walk up the perpendicular sides of trees, and is said when in confinement to be hard to retain in captivity. From this peculiarity, this curious feat is effected by the long toes and hooked claws, which I regret to say were in this specimen too much injured by the shot for me to be able to preserve what few had been spared by the murderous discharge. This bird is strictly nocturnal, diligently hiding itself during the day in the rushes; but if it happens to be surprised in the open, it stops perfectly still and assumes a stiff, unnatural attitude, wishing, I suppose, that its enemy should not recognize the fact that it is a bird at all, but merely a stump or branch of a tree. It has a great aversion to rising by daylight; when it does so it makes a great bluster, and flies very low, just above the tops of the reeds. The only way to make it rise is to come in an evening, when it ventures out into open in search of food; but if it once gets into the reeds, it is impossible to make it get up. It walks about with its long neck drawn in and its head thrown back, and when attacked it darts forth its head with such force as frequently to transfix its enemy. It is said to be bold and fierce. Its food consists of frogs, small fish, and water molluscs, and it is said when in captivity to attain great skill in catching flies. The nest is a large shapeless mass of reeds, twigs, moss and straw, laid together in either reeds or overhanging bushes, just above high-water mark; but it is never found more than 3 feet from the ground. The eggs vary in number from 4 to 6, and are pale whitish green, something the same colour as those of a duck, and take from 16 to 18 days to hatch. The young birds are fed by the old ones out of their crops. They do not put the food in their beaks, but lay it on the edge of the nest and let them

take it. The female absolutely refuses to leave its nest while incubating, and runs up and down uttering a sharp note of alarm, while the male watches the nest from his haunt in the reeds: though they are thus careful of the eggs and young, they leave them directly they are able to feed themselves. They are believed to have sometimes bred in England, and on one occasion the young birds were actually taken from the nest. The alarm note is compared to the barking of a large dog when heard from a distance, but the ordinary one is nothing more than a harsh croak. The plumage of the adult birds is the same in both sexes, but is not assumed by the female till it is of some age. The beak in the young bird is brown, but it becomes yellow in the adult. The feet and legs are pale green, the claws being yellow, much the same colour as the beak; the back of the neck is almost bare, but the throat is covered thickly with buff feathers; the tail is dark green and very small. The wings are also dark green and buff.

'I regret that there was hardly enough of the bird left to give an accurate idea of its appearance when alive, but Mr. Sidgwick says that, considering the condition of the remains when it was brought to him, it would have been a success if we had only succeeded in preserving one feather.'

L. Knowles (M) read the following paper on '*Roman Remains*':—

'This being the last time that I shall be able to address the Natural History Society as a member, I hope that I may be allowed to make a few remarks about the antiquities of the neighbourhood, so that somebody connected with it may be induced to pay attention to a subject which to me seems very interesting. What first made me think of looking for Roman remains was, first, the finding of part of a vessel (præfericulum), secondly, a lamp unique as a perfect specimen of its kind. A few weeks ago Mr. Bloxam made arrangements for a visit to Cave's Inn, on the Watling Street, and took me with him. We drove past Mr. Boughton Leigh's house at Brownsover; the rising ground on our right where the church stands being formerly occupied by earthworks in the territory of the British tribe Coritani; they are now almost entirely defaced. Where the road meets Watling Street we sent the cab back, and walked about a mile and a quarter to our right, noticing as we went the straight line of the road. This peculiarity is easily seen in any Roman road, as they never went out of their course for inequalities in the ground; in fact, we had to mount a rather steep bit before we could see the Inn in a valley before us. The spot where we got out is called Pilgrim's Lowe, from a man named Pilgrim who was gibbeted there some years ago. The Lowe (which is the ancient British name for tumulus) was probably some chieftain's, as an Anglo-Saxon sword was found a few years ago in a wood close by, which appeared to have been dug up and thrown there during the demolition of the mound. The Inn is now turned into a private house and farm, occupied by a Mr. and Mrs. Cave, not descendants

however of the Caves who were in possession about 300 years ago, but a newly-married couple from the south.

'It was not difficult to obtain their consent to look about in the pit on their side of the street, so we set to work at once. Before describing what we found, I ought to mention what kind of a place the pit is.

'To begin with, there is a slight rise in the ground from a brook about a hundred yards from and parallel to the road, on which we could see distinctly a large square in the meadow, and higher by about 4 ft. than the rest of the ground around it. The side of the square is about 30 or 40 yards, and the whole position of it is well chosen as a defence for the small valley, with the brook on one side and Watling Street on the other.

'The gravel pit is not worked now, and part of it is grassed over; but a small part extending over a corner of the earthworks is exposed—there we found numerous bits of pottery, but no perfect vessels. Some of them are very like those found at Lawford, probably coming from the same potteries, viz., the Caister in Northamptonshire. The most curious fragment found on that side of the road is a piece of a mortarium, easily identified by its having numbers of minute crystals or spar baked into its inner side, which scraped and rubbed down whatever was pounded against them. This is exactly like part of a mortarium found at Cilcheter by Mr. N. Hutchinson, who has also some other relics from that interesting town, such as a bit of Roman glass, some small bits of tesselated pavement. I am sure a paper on that place would be very interesting to the Society, when they hear that it is the best example of a Roman town in England. The streets are visible, I believe; oyster shells may be found in the fishmongers' shops, bones in the butchers'; houses still paved, and walls defined by long lines in corn fields, easily detected by their not giving soil to the roots.

'At the side of the pit we found a black patch of burnt soil, similar to that at Lawford, but much deeper, being about six feet deep and two or three feet wide, and therefore about double the size of the other. We did not notice so many red stones showing fire-marks as at Lawford, but found several bones about. Kirkpatrick, who was with us, saw at the top of the patch something white sticking out of the ground, which proved to be a boar's tusk, such as are frequently found amongst old remains of this kind. Unfortunately he pulled this tusk, and thus broke it from the jaw-bone, but by removing some soil the latter was found, and the tusk fitted to it. It is about three inches long, hollow, and very white; with the jaw-bone it measures about eight inches; and is like one in Mr. Bloxam's possession.

'The rest of the pottery on this side consisted of fragments of cinerary urns, with the exception of three very small bits of Samian ware, undoubtedly real. On one bit there is some impression, and some old letters, probably the name of the potter which it was customary to stamp near the neck or handle of the better kinds of

vessels; of course those of a later date. An example of a potter's name was exhibited before this Society last Term (by F. Willoughby) on the neck of an amphora found near Daventry. The letters printed on it were CIRCI, *i.e.* the genitive of Circus, the man's name. We walked round the earthworks, knowing that we were treading over numerous and perhaps valuable remains, proof being given us in our discoveries, and in those of the men who when working there found fibulæ or buckles, beads, and other curiosities.

'On the opposite side of the road we found several more pieces of pottery of the same kind, with the exception of some large fragments of a red vessel of very coarse ware, the thickness of it being, in fact, nearly an inch. These were probably parts of an amphora or large water jar.

'These earthworks Mr. Bloxam imagines to be the site of the old station Tripontium, and he has written me a long argument to prove his assertion, which might make this paper too long and more tedious. However he thinks that Lilbourne is not the old Tripontium, nor Rugby, though marked as such in some maps.

'Tripontium, by the way, does not signify a place of three bridges, but "town in the valley," from *tre* and *pan*, two old British words. If the Society desire it, I will leave with them Mr. Bloxam's paper for future consideration.

'Some fellows remark that these pieces of pottery are only modern flowerpots, but I have brought specimens of other kinds found with such pottery, which I hope they will allow to be Roman.'

H. F. Newall (M) read the following paper on '*Sound*':—

'I dare say you will remember a paper which Mr. Tupper read at an early meeting this Term on Mr. Crookes' experiments with light. It occurred to me that, as Mr. Crookes had apparently converted *light* into a motive power, it might be interesting to note the effect of *sound* on a wheel, or a light needle.

'Sound is vibration: consequently it is hard to get sound without the draught caused by vibration.

'Now Mr. Crookes in his experiments can do away with all the resistance of the air by suspending his wheel in vacuo, and then throwing the light on to one of the discs of the wheel. Well, of course I could not get rid of the resistance of the air in this way, for sound is not propagated in vacuo. Therefore it would take far greater power to move the wheel or whatever in these experiments would correspond to Mr. Crookes' wheel.

'Not seeing my way to collect the sound so as to move a wheel, I thought that the easiest way would be to suspend a needle very accurately. The needle I made as light as I could. It is made of a bit of a straw, with a disc of paper at either end. (See Fig. i. Plate iv.) This I suspended as accurately as I could by means of a hair. Fig. ii. shows another form of needle I have used. The discs are made of pith, and the two bars of very finely drawn glass tubing.

'Now if any force were exerted by the sound on one of the discs, it would be repelled from or attracted to the point where the sound was strongest.

'The next thing to be considered was how to collect the sound. Most of you, I hope, have seen the beautiful effects obtained by sprinkling sand on a plate of metal or glass, and then sounding the plate with a violin bow. The plate vibrates strongly, and the sand leaves the places where the vibration is, and moves on to the places where there is no vibration. (See Figs. v. vi. vii. viii. ix. x. of Plate 4.)

'These places are called the "nodal lines," and are formed by the vibrations of the plate being in opposite directions on those lines, and thereby counteracting one another. From this fact I knew that the vibration was strongest in the places where there were no nodal lines; therefore I suspended the needle about half-an-inch over the plate, so that one of the discs came over one of these places, (see Fig. iii. of Plate 4); and then I sounded the plate. To my intense astonishment the needle dipped most distinctly towards the plate!

'I sounded again, getting more intense vibration, and the needle actually dipped right down on to the plate, and then as the sound, and therefore also the vibration ceased, it rose again.

'I sounded again: the needle dipped: I continued the vibration strongly: the needle clung as it were to the plate: I continued the vibration still further, and the needle turned on its centre, trying to move away on to a nodal line. This last movement is intelligible; for it is simply the action of a detached piece of paper, which like the sand moves about with the vibration, trying to get to a place of rest. But why is the needle attracted at all? Electricity was suggested by several people; but glass is a non-conductor, and therefore electricity would only be generated where the glass was rubbed by the bow. And even granting that electricity could be generated at all, surely sufficient could not be produced to attract a thing at least half-an-inch off the plate.

'And again: when I placed the disc above a nodal line, where there was no vibration, no motion was produced in the needle.

'The next experiment I made was to stretch a string tightly, so as to produce a distinct and strong note. Over this I suspended the needle about half-an-inch above, and struck the string. The needle immediately dipped on to the string. This occurred whether the string was struck sideways, or vertically.

'As I saw Mr. Worthington shortly after making these experiments I told him of them, and the next day he came to my study, and we went over the experiments again, and made some additional ones.

'With the string we noticed that when the disc was placed half-way down the string, and when the string was strongly pulled down and then let go, the disc was repelled; but when the string was pulled up and let go, no movement was seen in the disc.

'Again, when the disc was placed quarter-way down the string, it was attracted in whatever way the string was pulled. These facts

seem to show that there was a nodal line in the middle of the string, and therefore when the string was strongly pulled down and let go, the draught which the string makes in rising rapidly repels the needle; whereas when the string is pulled up and let go, the draught produced is not in the direction of the needle and does not affect it.

'In the case of the plate, the explanation which proposes itself after electricity, is that a draught is caused by the vibration of the plate to descend upon the disc. Then to do away with the draught, if possible, is the next thing to be tried. Accordingly we enclosed one of the discs in a pill box with a slit in its side, to allow of the vertical movement of the straw. Holes were made in the top and bottom of the box, which with the disc enclosed was suspended over the plate, which was then sounded. The needle dipped. But this experiment was by no means conclusive of course: for there is, firstly, the draught which may pass through the holes in the top and bottom of the box, and, secondly, there is the part of the needle outside the box, which of course is still liable to be affected by the draught.

'Therefore the next experiment to be tried was to suspend the *whole* needle within a box, and to fix the box above the plate. For this I made a box with glass sides and top, and with a bottom of cardboard, above which I suspended the needle as accurately as I could. In this box there was no hole. Unfortunately I found that the bottom of the box vibrated when the plate was sounded, so that it in turn would make a draught within the box, which would affect the needle.

'However, on getting a different note from the plate, which did not make the bottom vibrate, the needle dipped. This experiment however is not to be relied on; for, of course, the cardboard most probably moved.

'I next suspended a needle in a box wholly of glass, which I made as nearly as I could air-tight. This I fixed over the glass plate, but, as was to be expected, the sound had no effect on the needle.

'Another suggestion occurred to me. Could it be possible that the air should in a way act in the same manner as the sand, that is, move off on to the nodal lines, thereby causing a partial vacuum underneath the disc, a vacuum which would have to be filled up, by air rushing in from *above* as well as from other directions, and in that way pressing the disc down on to the plate? (See Fig. iv. Plate 4, where the lower arrows show the direction of the air, set in motion by the vibrations and the upper ones, the air coming to fill the vacuum.)

'I have not had time to make any experiments to see if there was any side draught. But one other one which I have made, and which I have not mentioned, may throw some light on the subject in other people's eyes;—for I cannot draw any inferences from it;—and they say some people can see in a thing what others fail to see.

'I fixed a piece of cardboard above the plate, cutting a hole in it so that the needle could just work in it without touching the sides,

and without leaving any unnecessary space between the needle and the sides of the hole; I wished to see if I could prevent draught from coming above the disc. When the plate was sounded, if the disc were exactly on a level with the cardboard, no movement was seen; but if it were either above or below the level, the disc passed through the hole and oscillated backwards and forwards, with gradually diminishing strokes, until it was at rest on a level with the cardboard. Of course I cannot positively assert that there was no vibration in the cardboard, but I certainly did not detect any.'

E. J. Power (M) read a paper on '*Sticklebacks*,' giving some interesting facts observed in his own aquarium.

MEETING HELD OCTOBER 9. (49 present.)

Donation: Fossils and shells, by W. B. Lowe (C), who read a short note about the Crag-beds of Suffolk; List of plants found near Daventry (see Statistics, at the end of our Report) by F. Willoughby (A).

Exhibitions: Whitby fossils, and local specimen of Red Underwing, by the President: Pupae of Humming Bird, Hawk-moth, and Swallow-tail Butterfly, by C. Bayley (M): Drawings of Roman implements and urns, from near Daventry, by F. Willoughby (A).

The President then detailed to the Society the recent investigations of Mr. G. Darwin into the results of cousin's marriages. He had asked various schools for statistics about their athletes, to see if fewer than the normal proportion of these were sprung from marriages between cousins. In the case of Rugby the 34 best Cricket and Football players and runners were selected; but none were sons of cousins. So few schools however had replied that no trustworthy conclusion had been arrived at as yet.

Papers: Mr. Kitchener read a note on '*Carnivorous Plants*,' of which the following was the substance:—

'A plant, Selene noctiflora, has been found between the Hillmorton roads. This, though not proved to be carnivorous, is yet allied to others which are. I have gathered a plant which had at least 20 flies and other little specks of various substances upon it. As far as I have been able to make out, these substances were not digested by the plant. It is possible that this plant, which is not mentioned in Mr. Darwin's new book, is, so to speak, halfway between the ordinary plants and those which are proved to be carnivorous; *i.e.*, that it catches insects, but for some reason does not digest them. Further investigation of these plants is much to be desired.'

H. Vicars (M) read the following paper on '*Spiders.*'

'A spider is generally supposed to be a hideous, repulsive insect with long hairy legs, a fat body, and an unlimited number of eyes: and this somewhat exaggerated notion is founded on the appearance of one particular kind, viz. the common house-spider, which certainly is as unprepossessing an insect as lives. But all spiders are not hideous, and *no* spider has an unlimited number of eyes; as a closer inspection of different members of their race will show. Spiders have long had the reputation of being venemous, even to the extent of causing death: but this is by no means true of any English species, (none of which have the power of inflicting a wound of any severity), and doubtfully so of any foreign species: though a certain gentleman, credulous as those of his time, writing from Gascony, declares that there are in his country 'spiders of that virulency that, if a man treads upon them to crush them, their poison will pass through the very soles of his shoes.' We do not like to disbelieve him, but we cannot help finding his statement a little startling. There is however a certain amount of foundation for these charges brought against spiders: they undoubtedly do possess a certain poison which is secreted in their fangs, and used for killing their prey: but it is so comparatively weak, and so small in quantity, that it produces no effect (or scarcely any) upon human beings:—this I mean of English spiders. Spiders have been tamed, and are said to like music; how far this latter is a fact we cannot be quite sure. Our ancestors, even as late as the beginning of this century, believed in and used the spider as a medicine. It was administered in various ways. For intermittent fever a little spider's web was given: to cure children from ague 'a large spider was confined alive in a box and suspended round the patient's neck': black spider's web cured also 'pains, delirium, griping, and other distressing symptoms,' which could not be removed by ordinary remedies: 'swallowing a spider gently bruised and wrapped up in a raisin, or spread upon bread and butter', was an excellent cure for some complaints. We may, I think, safely conclude that either nature unaided, or the disgust caused by having to swallow a squashed spider spread upon bread and butter, really removed the disease, and not any attributes of the spider himself.

'As early as the beginning of last century attempts were made to use in manufacture the silk spun by the spider. The silk woven was of a beautiful grey colour, and nearly as strong as that of the silk-worm. There were several difficulties however attendant on the use of this substance as a manufacture. Firstly, if the spiders were kept together they would eat one another; which was rather a drawback. Secondly, the threads were not nearly so strong as those of silk-worms, rendering them liable to break in winding. Thirdly, it was found that it would require 27,648 spiders, *all females*, to spin a pound of silk; whereas the same quantity could be spun by 2,304 silk-worms. Several attempts

have been made to use spider's silk, but all have been abandoned as useless.

'Another form of spider's web which has called forth many strange opinions, is the 'Gossamer.' A scientific man in the 17th century imagined that the white fleecy clouds which one sees in summer were composed of cobwebs! In poetry generally we find the gossamer described as dew. Formerly it was supposed to cause rot in sheep.

'But now we must turn from superstition to fact.

'Anatomically a spider forms an interesting study, that is, to those who can succeed in dissecting them and like performing 'post mortems.' I thought I should like to see what a spider's inside was like, so I determined to make an examination. I selected a large, fat spider, and when I had killed him by pouring boiling water upon him, I proceeded to my task; but, to my grief, with the first touch of the knife he burst, and left me nothing but a squashy mass of dark brown matter—it did not look nice, so I did not again pursue my inquiries upon the insides of spiders.

'The following information about the anatomy of a spider I have derived almost entirely from books. Externally the spider is composed of two parts: the fore part, including the head and chest which are not separate, is called the cephalothorax; the hind part is called the abdomen, and is joined to cephalothorax by a fine tubular stalk. In front of the cephalothorax are the *eyes*, which are 6 or 8 in number and simple. Upon their position and grouping (for they vary much) depends the distinction of the different genera: sometimes they are raised on tubercles; sometimes on projections of the cephalothorax:—it not unfrequently happens that one or two eyes are wanting. Below the eyes are the *forceps*, which are attached to the face by joints, perpendicularly to the breast (except in one genus), and have a lateral motion. These organs contain poison, which is conducted down a canal in the fang and emitted at a small opening at the tip. Below the forceps is the *mouth*. The legs are 8 in number and are connected by joints with the cephalothorax. The foot is very complicated, being fitted with toothed claws and bunches of hair. At the extremity of the abdomen are 2, 3, or 4 pairs of spinnerets: the tips and lower surfaces of these are furnished with numerous minute tubes through which the silk issues. The silk itself is a viscid fluid secreted within the abdomen in glands, which communicate with the spinnerets by small ducts, becoming hard immediately on being exposed to the air. The spider's *breathing apparatus* is curiously placed. Underneath the abdomen and near the cephalothorax two scales are seen, which are the openings to the gills: attached to the gill is a tough ligament which, passing upwards, is attached to the pericardium or outer membrane of the heart: consequently the dilation and contraction of the heart causes the gill to close and open, alternately emptying and filling it with air.* *The heart*

* The middle of one's stomach strikes one as being rather an odd place to have a nose!

is placed lengthways on the upper part of the abdomen. Spiders have a circulatory and respitatory system, on the same principle as that of animals, though tracheæ or air tubes also are found. Thus they have a claim to rank higher in the scale of creation than true insects, in which the system of arteries and veins is wanting; and there being no lungs or centre of respiration, the oxygenation of the blood is performed by its exposure to air, admitted through a series of breathing holes into two main tracheæ or windpipes, and thence carried by innumerable tracheal branches to every part of the body. The digestive organs are complicated, and exist partly in the cephalothorax and partly in the abdomen. The nervous system of spiders is somewhat similar to that of insects, consisting of nerve-knots situated in the cephalothorax, which send off nerves to every organ of the body. Spiders possess the sense of touch, sight, and taste; though this last is only deduced from their habits, and not from a knowledge where the organ resides. We do not know whether they possess the sense of smell or not. The number of legs, the absence of true antennæ, the structure of the mouth, the presence of none but simple eyes, the combination of head and chest, the absence of articulation of the integument of the body into segments or rings, at once distinguish the spider from the true insect, and entitle it to a higher rank in nature than its unprepossessing outside would warrant.

'Spiders change their skins several times before arriving at maturity, but undergo no metamorphoses similar to those of insects. At the time of moulting any leg or other member that may have been broken off is often partially reproduced; and in subsequent moults is reproduced further. It is not accurately known how long a spider lives, though some have been known to live as long as four years.

'I shall almost entirely omit all mention of the different tribes, genera and species, and touch upon only one or two leading facts and distinctions: I know that long-winded generic and specific names are above all things tedious, so I will, as far as my subject allows, avoid them.

'Spiders have very different ways of catching their prey; and it is by these habits, among other things, that the various genera are distinguished.

'Perhaps the best known of all is the spider, or rather family of spiders, that makes the common geometrical web, consisting of circles and radii. Though this web is extremely common, it may not be amiss to describe how it is made: for though every one knows that a spider's web is made by a spider, comparatively few know how the spider performs the operation; and books, at least as far as I have seen, are equally ignorant of the truth. Probably the majority of people imagined, (if indeed they ever took the trouble to imagine at all,) that a spider's web,—that is, one of this Family 'Epeïra,'—consisted of a series of circles, each one complete in itself, supported by a number of radii. In books I find a web

described, 'the radii are made first by the spider: when these are completed, to the central point a thread is attached, which is drawn from radius to radius, advancing from the *centre to the circumference*, until a nearly circular area is occupied by a spiral thread intersecting the radiating lines.' That this is erroneous I will afterwards show: that the former is even more erroneous I will prove at the same time, if indeed proof be wanted.

'The first thing a spider does on beginning his web, is to let out from his spinnerets a quantity of fine, separate, sticky threads: these are carried by the wind and adhere to the first thing they touch: the spider then runs along this, carrying with him another thread, and fastens both at the point where the first stuck. Then he either drops down with a thread for the side supports, or exposes some more silk to the wind; and so on till he has made a sufficient rough frame-work for the web itself. Then as nearly as possible he divides the area of the frame-work in half by a thread which represents the diameter of the future web: from the centre of this diameter to the circumference, (as we shall in future call the frame-work), he draws another thread, which is the radius of the web: running down this he carries a thread which he fixes to the circumference about an inch or ¾ of an inch (in a large web, perhaps 2 inches) from the first radius; and so on all round. When the radii are complete, the spider returns to the centre of the web, and pulls them all together to see if they are firm. If satisfied on this point, he attaches a thread to the centre and makes a very small close spiral of not more than three rows deep round the centre. He then goes a short way down one of the radii and attaches a fine, thin thread, which he carries loosely and far apart towards the circumference, which, however, he does not reach. Then he goes close to the circumference and attaches a thread to a radius close to its end—this thread, it is worth remarking, is of quite a different nature to any we have yet seen, and its peculiarity lies in its being covered by viscid globules placed at regular intervals, and easily discernable with the naked eye: it is very elastic and not particularly thick. This he carries round, attaching it to each radius in turn in a spiral, from the *circumference to the centre.* Whilst performing this operation, he walks along the radii and the loose spiral line which he had made previously. This latter he breaks away with one of his hinder legs as soon as the final spiral has been brought sufficiently close for the spider to be able to get on without it.

'But this final spiral is not carried quite up to the centre; for in a large majority of cases, a space is left quite without any threads crossing the radii, between the end of the spiral and the centre, in which there would have been room for four, or at the least three, rows of spiral in addition. This however is not *absolutely always* the case, but certainly is in a *vast majority* of webs.

'The spider has also a retreat, or house joined to his web, by several strong threads. The retreat itself varies in form according to the genus and species. Sometimes the spider is to be found in

his retreat; sometimes in the centre of the web, and in this case always head downwards.

'One species departs from the usual spiral plan of the web, by leaving an isolated radius as the pathway to its retreat. In this web, therefore, in place of the spiral, is a series of incomplete circles.

'The two other best known families of spiders are the Agelenidæ and Linyphiidæ: to the former of which the common "house spider" belongs; and to the latter of which belong those spiders which spin the horizontal sheets of web attached and held firm above and below by more or less perpendicular lines of silk. In these webs the spider may generally be seen hanging on to the bottom of his web upside down: in the former the spider always has a tubular retreat in the corner of his web, which is generally built in the angle of a wall. I have nothing much to say about either of these families, as I have observed them but little, and have found out nothing worth repeating. So I will return to Epeïra.

'I thought it might be interesting to get some idea of the amount of silk used in making a web of largish size. So I measured as accurately as I could: I found that there were 24 radii, and that the average length of a radius was 6 inches, which gives us 4 yards at once. There were 30 rows of spiral: the circumference of the outside row was 39 inches; the inside row was between 10 and 12 inches in circumference. All this does not include an endless number of side supports gone over several times for extra strength; nor the smaller spiral round the centre; nor the loose, thin spiral used in the construction of the web and afterwards broken away. Some mathematician might kindly give us an estimate of the probable amount of silk altogether expended on a web of this size.

'One spider was kind enough to spin me 24 yards and a half (at the *very lowest* computation) of strong silk: this much I accurately measured: but besides this, he let out a great quantity of fine, sticky threads (which, by adhering to the first object they touch, form a new line upon which to go): at a guess I should say that he spun at least 12 yards of this. To my certain knowledge, he eat 7 yards of the silk which he had spun:—this statement may sound rather startling to the uninitiated; but it is a fact that when a spider has got a lot of broken or waste web which he cannot easily get rid of otherwise, he rolls it up into a little pill and eats it, apparently with great gusto. The spider in question was not a large one, and had spun his own web that same morning. I did not measure his web, so I have no idea of its size. I ought to have stated before that after 24½ yards he refused to spin any more—perhaps he couldn't.

'The species of which this spider was a small specimen (probably only half-grown) is singularly ferocious and barbarous in its habits. Commonly it is called "the garden spider," but its scientific name is "Epeïra diadema." Probably it is well known to

many by sight, for it is a handsome and conspicuous spider. Its colour varies from dark brown to yellow; its back is marked with a series of white spots which form a distinct cross.

'If one of these spiders by any accident gets into the web of a brother or sister (for, shocking as it may seem, the ladies are even more ferocious than the gentlemen), a battle of the fiercest nature follows; if they are equally matched, the combat will be a long one, and probably fatal to both; if, on the other hand, one is stronger than the other, the weaker makes a dinner for the conqueror. To prove how ferociously greedy they are, we have only to hear that a spider will suck his own blood when slightly wounded. A short time ago I saw one slightly wounded on the back of his abdomen by another: when he had sufficiently removed himself from his adversary, he proceeded to dip his leg in the juice (I can hardly call it blood) which had oozed from the wound, and suck it; he repeated this operation until apparently tired by the awkwardness of conveying his leg to the middle of his back. Slight wounds such as these, I believe, heal very quickly, and cause no permanent harm to the sufferer. All the spiders of this species have a way of rolling up their prey in silk which they spin out for the purpose; thus effectually stopping all struggles on the part of their captives, and thereby rendering them much more convenient to eat.

'There is also another species of spider which is well worth mentioning. For a good many years I have noticed this spider and its habits, and even now I know very little more about it than I did at first: that is, as regards its name and true nature. About eight years ago I remember first noticing them, and then I christened them "Thieves," for want of a better name. For the same reason I call them so still. First, I will describe the spider; then, its habits as far as I know them. Its body is long and thin; the cephalothorax of a reddish brown; the abdomen lighter; the forceps are large; the legs are very long and hairy, red brown in colour, with darker hairs; the front pair are especially long. When frightened it sticks itself out, and looks like a bit of dead leaf or stick—in this position it is about three-quarters of an inch or an inch long. Its habits are what may be strictly called predatory: as far as I know, it never spins any web. It obtains its food by taking up its position on the web of another spider, remaining just at the edge. When a fly is caught in the net, the owner of the web goes to secure and kill it. As soon as this troublesome operation is over, up comes the "Thief," waving his long front legs, and frightens the rightful owner away: and then, seizing the prey, carries it off for dinner. Sometimes, however, the owner does not submit so placidly, and endeavours to defend his capture; if he is strong enough, sometimes he succeeds in repulsing the "Thief:" if too brave and not strong enough, the "Thief" seizes him, and as often as not eats him. After this summary and impolite proceeding, he eats the fly before captured, and takes possession of the web. Sometimes more than one Thief attaches himself to

another spider's web: then the results are sometimes complicated. The following is a correct representation of what happened in one instance under my eyes. There was a web with an owner and two "Thieves": a fly being caught, the owner secures and kills it. Thief No. 1 comes up and tries to take it away: the owner objects: while they are parleying, Thief No. 2 comes up and closes with No. 1. Thief 1, being stronger, beats him and drives him off: No. 2 falls down out of the web, No. 1 falls after him to chase him right away: on coming back finds the owner engaged in sucking the fly: at once he drives her away, but she comes back: he then makes a jump, and seizes her on the underside of her thorax, at the root of her legs: in this position they remain for some seconds: then by a sudden effort she gets away, and he walks after her slowly all over the web. While they are thus engaged, a third still smaller Thief appears, and takes advantage of the opportunity to seize the prey: so cutting off the threads all round it, he attaches it to his body and makes off with it as fast as he can out of the web over the leaves of the shrub. Finding the prey gone, the owner and Thief No. 1 walk off in different directions, looking depressed and scored off.

'I should be very glad to have any light thrown upon the name and habits of these remarkable spiders, which are really interesting and amusing.

'There is one other kind of spider worth mentioning, viz. the Salticedæ. These animals obtain their food entirely by seizing their prey openly. Their name denotes their power of jumping, which they use in getting food: creeping up cautiously behind an unwary fly, suddenly, with a leap, they are upon the back of the unfortunate insect, sucking out its life blood.

'It was commonly supposed that spiders, to get their web suspended between trees, jumped the intervening distance: but the only spiders who have any more notion of jumping than cows are these in question, which spin no webs.

'I am aware that I have left out a great deal, but if I were to have written everything, I could have gone on talking for a month without stopping: this would have been tedious, so here I will end.

'P.S.—I have just heard, upon unimpeachable authority, that if you cut a spider in two neatly, the insect seems greatly rejoiced, and runs away without its tail very much more rapidly than it would have done with it! I hardly know whether to believe this assertion.'

MEETING HELD OCTOBER 23. (87 present.)

Exhibitions: Specimens of minerals, by Rev. T. N. Hutchinson. List of plants, by H. W. Trott (M), (see Botanical Report).

Papers: Mr. G. M. Seabroke (c) explained the method of regulating clocks to go accurately together, by means of electricity.

Dr. Sharp (H) read a paper on '*Medicines*,' of which the substance was as follows:

> 'Every natural substance which is not food is capable of being used as medicine. All medicine is injurious in health. Each drug acts directly on a particular part of the organism.'

These principles were clearly enuntiated and illustrated.

MEETING HELD NOVEMBER 13. (75 present.)

Exhibition: A book from Ceylon, made of dry glass, by the President.

Papers: H. W. Trott (M) read a paper on '*Parasitic Plants*;' in the course of which he mentioned that they sometimes assumed gigantic proportions; for example, one was known to have grown to be 3 feet thick, and to weigh 16 lbs.!

The President explained the working of the papyrograph, exhibiting the instrument, and illustrating the process.

> 'The paper is coated with shell-lac: the ink is a strong alkali, coloured. When laid on the uncoated side of the paper, it sinks in, and dissolves the coating; the dissolved parts are washed away, leaving a stencil through the coating, corresponding to the writing on the surface. The surface is then covered with aniline dye, thickened with glycerine, which penetrates the thin paper, and is forced by pressure through the holes in the coating, thus printing an impression.'

A drawing was made by H. F. Wilson (M), in the presence of the Society, and copies were struck off.

H. F. Newall (M) read the following portions of his essay (which obtained the Society's prize in 1875), on '*Impressions*':—

'The most common illustration that can be given is, I think, the impression produced by the sun on the eyes. Every one is, of course, familiar with this. When one looks at the sun for one or two seconds, at first one is quite blinded by the intense light: but on looking at some other part of the sky a moment later, one sees an image of the sun. But perhaps every one has not noticed that the image is scarcely ever single, but nearly always plural, there sometimes being so many as five images. Nor, perhaps, has every one taken the trouble to observe the different changes of colour through which the images of the sun go. Roughly speaking, the changes are as follows:—(i.) yellow; (ii.) green; (iii.) blue; (iv.) a sort of dirty black purple; changing slowly to a (v.) slight purple;

(vi.) brick-red; (vii.) and lastly, a beautiful pink;—in fact, changes through the prismatic colours. Another fact to be noticed is, that at times one of the images is in advance of the others in the changes.

'The reason for the plurality of images is, I think, possibly this. For an instant one part of the *retina* of the eye, and then another part, receives the image, and thus two images are formed: and in a similar manner four or five would be formed by the image being thrown in succession on to four or five different parts of the *retina*.

'Another example of *visual* impressions is the following:—Whilst drawing the curves for the Natural History Society's Report, I was so constantly looking at curves being made in such numbers, that on whatever I happened to cast my eyes, I saw the image of a curve. This was most noticeable on the top of a straw hat—why, I do not know.

'A third example of the same impression is this. I had been watching the formation of sand into nodal lines on a plate of metal; and after having been doing this for some time, I went up into the observatory, and on looking into the telescope, I was amused by seeing all the stars in the field apparently running away, and forming themselves into nodal lines.

'The following example shows how very annoying an impression sometimes becomes. Some years ago I was very much amused with the problem of the "Knight's move:" and I made a great many solutions of it. After puzzling at them for some time, I got so fully saturated, so to speak, with "Knight's moves," that everything I looked at arranged itself into a "Knight's move." Whenever I looked at anyone's face, his eye, nose, and mouth immediately became prominent, and formed themselves into a "Knight's move."

'The following remarks are not so much about impressions as optical delusions. Sitting in chapel in the sunlight, which came through one of the stained windows, I was surprised to see so much colour in the shadows, and I determined to make a small study of the subject, and notice the colours of all shadows that came in my way. This I have done to a slight degree, and find that the colours of all shadows are simply the contrast colours of the light:—thus, if the light is red, or red-purple, the shadow is green; blue light throws a yellow or orange shadow; and, *vice versa*, green light makes a red shadow, and orange or yellow will cast a blue shadow. But another curious fact connected with these coloured shadows is this:—that when there are two or three colours in the light, the blue and yellow are in the shadow nearly always arranged on either side of horizontal lines, whilst green and red are on either side of the vertical lines.

'Last Term some one told me of this curious fact that he had noticed. He said he had placed a piece of paper in a horizontal position between a candle and a window through which daylight was still coming. On this paper he set another bit at an angle, so that it cast a shadow towards the window: and this shadow was

distinctly blue. Well, the explanation of this is as follows, I think: the flame of the candle is orange-coloured, and therefore the shadows in this light would be blue.

'Some time ago my father and I were looking at the Ring Nebula through the telescope, and my father asked me if I saw the inner part red; but I could not. However, when my father had drawn it with a white pencil on black paper, and when he held it in the light, I immediately saw the inner part red, and asked him if he had used any red pencil; but he had not. I think the colour was purely an optical delusion.

'Now let us pass on to examples of impressions on the *hearing* nerves. Every one, I should think, has heard a note buzzing in his ear long after the real note has ceased. This example will illustrate it well. I caught a bee, and got its note, which I whistled for a moment or two, and then went and found what the note was on the piano. It was G above the middle C. After this I weighed the bee, and measured its wing, which operations occupied about five minutes, and still I fancied I heard the note in my ear, and I whistled it again. A fellow who was with me said, "Now we'll see how much you have gone wrong," and going to the piano he sounded the note I was whistling, and it was G.

'Another example may be taken from a thing which was very annoying to me. When I have been working in my study, and heard the chapel clock strike, I have often fancied I heard it strike the quarters three or four times, and I have started up in a hurry only to find I was wrong.

'To find illustrations of impressions produced on the remaining three of our senses, namely, *smelling*, *tasting*, and *touching*, is a very difficult task—so difficult that I am afraid I cannot perform it. To my mind, it is a great mistake to make two senses out of smelling and tasting: for they are the same thing. Tasting is smelling: for try to taste a thing when you are holding your nose, and you fail; but the moment you let go of your nose, you can taste the thing you are trying to taste. The difficulty in finding examples of impressions on smelling and tasting nerves lies in the impossibility to prove that the substance from which comes the smell or the taste has really gone.

'Examples of impressions on *touching* nerves, I cannot find; so let us pass on to examples of *muscular* impressions. In crossing the North Sea on our way to Norway, at the beginning of August, the ship pitched a good deal, and on getting to Christiania, though the sea was perfectly smooth, yet we distinctly felt the boat pitching; and what was still more curious, when we were walking in the streets of Christiania, my brother bumped up against me, and said, "What a lurch the ship did give there:" and so I found he was suffering the same feeling as I was, a feeling that did not leave us for nearly four days. This feeling was due, I think, simply to the fact that certain muscles had been called into play to balance the body, and had got so accustomed to being in constant use that

they moved even when there was no need of it; and so it appeared that the "ship gave a lurch." One could find many other examples of this impression, but this one, I think, will be sufficient to illustrate it.'

MEETING HELD NOV. 27. (44 present).

Exhibitions: Animals from Ceylon preserved in spirits, sent by A. Gray (O.R.): The local collection of Lepidoptera, which obtained the prize, by C. Bayley (M).

Papers: H. F. Wilson (M) read the following paper on the '*Broads.*'

'The subject of my paper this evening is the Broad District of Norfolk, a locality but thinly inhabited, and rarely visited by the enthusiastic tourist—in fact, it is not a place for the tourist, except for the few who desire repose and not bustle, and prefer the untrodden solitudes of nature to the doubtful delights of a crowded watering-place. Before beginning to say anything of the broads themselves, I must speak for a short time about the general character of the county where they lie—a county much abused, but yet a county which produces the daintiest bloaters, the heaviest turkeys, and the most astounding dumplings. It is a good deal behind the age, certainly, in many ways; the railways which pass through it are marvels of bad construction, and management still worse: its chief town, Norwich, is as sleepy an old place as you could well find if you searched England over; its population is purely agricultural, and agricultural pursuits imply stupidity — in many cases this stupidity is alarming: but, apart from all this, there is much in Norfolk that can compete with any other county in England. It is quite out of the ordinary beat: it is on the road to nowhere: hence it is always quiet, and travelling agents, the bane of the midland counties, are unknown. There are no great manufactories: no collieries: and consequently the discomforts experienced in other neighbourhoods from these causes are absent. The people, if stupid, are civil: their language, a marvel in itself, is pitched in a most cheerful key: they never drop their *h*'s, which I have heard is the case elsewhere. It is one of the best, if not the best, county for game in England, and the Prince of Wales lives there.

'But alas, Norfolk is *flat*, undeniably *flat*:—I do not, for a moment, mean to say that there are no pretty districts in it, for that would be very far from the truth: the northern part of the county, round Cromer, and again near Sandringham, might compare with any English rural scenery in beauty, and it is not only its inhabitants who say this: but a great part of the county, and unfortunately, that part through which the more important railways run, (and hence comes the bad impression of the general character of the scenery) is as flat as a pancake:—indeed the traveller, in the winter months,

is astonished to find himself in the midst of a vast watery plain, stretching as far as the eye can reach, and sometimes sees, in dismay, the water rising over the railway itself. From these remarks it will doubtless have been gathered, that the river-system of Norfolk is by no means striking, that waterfalls and such aquatic phenomena cannot be produced at any price. This is the case. The rivers, after sluggishly winding through the flattest of agricultural and pastoral districts, fall by a descent of about 5 feet in 30 miles or so, with a sort of imperceptible motion into the German Ocean. The tides of the aforesaid ocean make their way each day up nearly to the source of these slow-going streams, far away in the middle of the county. And such is the county which produces the Broads: large shallow lakes of brackish water, overgrown in part by weeds, and abounding in fish: whose average depth, though they spread sometimes over an area of miles, is somewhere about 8 or 10 feet: where you will see birds of all denominations—sea birds, land birds, marsh birds, moor birds: where pike attain a terrific size, and chub and bream, from years of idleness and repletion, become very monsters of the deep.

'They are 20 in number, scattered over an area of about 350 square miles: the largest being a fine sheet of water, about 3 miles by 2, by name Hickling Broad. I went all over this district last summer, with my brother and another friend, in a small sailing boat; and what with sailing, rowing (occasionally), bathing, shooting, fishing, and sundry other employments, we managed to spend ten days or so in a most agreeable manner. Starting from Norwich at about 11.30, we made the head of Breydon Water at Yarmouth before night, a distance of over 30 miles, having the wind to help us most of the day. On the following day, after cruising about Yarmouth harbour, and an hour or so spent on the open sea, we left the town and rowed on the flood tide up the Bure, the river into which most of the Broads flow, about a dozen miles to Acle Bridge, one of the few bridges in the neighbourhood where the few passengers there are transported across in ferry-boats. Acle Bridge is chiefly, I may say solely, remarkable for a public house whose landlord, when the weary traveller seeks a bed after the labour of the oar, comes out and swears persistently that he never receives anyone at that hour of the night, and cannot be induced to do so. This is indeed a common failing about there, and must be a truly disastrous policy in a neighbourhood where one traveller per month is about the usual thing. At one place, when the shades of evening were closing in, and we knocked at the door of what seemed by its sign to be a house of entertainment, we were met with loud abuse and threats of the kitchen poker. But for all this we were never so unfortunate as to be obliged to camp down in our boat, which was too small for the purpose, and always by dint of perseverance obtained shelter for the night. After two or three days of this sort of work, varied occasionally by the aid of a barge, whose tow-rope proved an agreeable rest after an hour or two spent in rowing, we

finally reached the object of our destination, and found ourselves among the Broads themselves. They are admirably adapted for sailing, as one gets every breath of wind there is without any of the obstacles which make lake-sailing generally so dangerous, and the only requisite is a boat that does not draw too much water. Horsey Mere, the Broad which is nearest to the sea (about a mile off), receives the drainage of the salt-marshes, which are only separated from the shore by a low shifting range of sand hills, and carries down to the sea again, through the long network of broads and canal-like streams, some of the very brine which has filtered into the marshes a dozen miles to the north.

'Before I stop I would mention a striking instance, which bears out the principle of Mr. Newall's interesting essay read to the Society a fortnight ago. We had stopped one day for a long time before a bridge, beneath which a barge was moored, and the impression was, I suppose, firmly fixed in our mind's eye. That same evening, six hours after the occurrence, we reached the inn at the head of Hickling Broad, and put up for the night in two rooms of about 8 ft. by 10. Now it had always happened that I had gone over again in my dreams the various events of the day, and had spent the night in a sort of troubled attempt to reproduce those events; but this night something much more striking took place. My brother and I, from the want of accommodation, were sleeping together in one of the above-mentioned rooms, and after various misunderstandings and mutual abuse, had sunk into a sort of mockery of sleep. At once I was in the boat, rowing for bare life;—now I was steering and keeping a good look-out ahead, when suddenly there appears, right in our way, the bridge, beneath it the barge. Of course I sung out at once, and was promptly checked by my brother, who wanted to know what all the row was about. I endeavoured to impress upon him that we were going hard all into the bridge, and pointed it out to him. "Stupid fool," he replied, "that's only *the window of the room, with the looking-glass in the middle of it.*" Amusement was the result. But hear me further. After half-an-hour or so, my brother woke up, saw the bridge, barge underneath, all correct, and was completely taken in himself. This time it was my turn to laugh.

'But to return to my subject for a few words more; the Broads that are farther inland, at Hoveton, Salhouse, and Wroxham, are more picturesque, if not so wild as those near the sea. They are much resorted to by gentlemen from London of the piscatorial persuasion, and for this reason are not so pleasant. Nothing in my estimation comes up to the lonely solitude of Horsey Mere, where no sound is to be heard save the melancholy calling of the curlew, or the flapping of the wild duck's wing: where not a house is to be seen for miles, and the low sand hills that fringe the lonely coast are visible on the horizon. Such are the Norfolk Broads, and as such are well worth visiting by those who care for Nature in her every aspect.'

Dr. Sharp (H) read a second paper on '*Medicines*,' of which the following was the substance:—

'Every medicine has two ranges of doses, a larger and a smaller, producing opposite results: for example, a certain dôse of Monk's-hood makes the heart go faster, while a smaller dose makes it go slower. Thus drugs under certain conditions may be antidotes to themselves.'

MEETING HELD DEC. 11. (63 present.)

Papers: Mr. Tupper (H) read the following paper on '*The Fossil*.'

'More than a year ago Mr. Wilson brought me the specimen, which is the subject of this paper, for my opinion, whether photography would succeed in representing it adequately. I thought it would not do justice to the details, and advised that a very exact drawing should be made from the original, and photographs then made from the drawing. The accompanying heliotype is the final result of the course kindly adopted by Mr. Wilson at my suggestion, while the paper itself, which is nothing but a transcript of notes made during my study of the fossil, is also the result of Mr. Wilson's kindness in substituting these notes for his intended contribution to the Geological Society. I have therefore to thank the Geological Society for allowing me to publish this paper, which the council decided should be printed in abstract—an abstract I have not yet supplied. (The heliotype mentioned is Plate 1.)

'The original drawing (now belonging to the Geological Society) I made directly from the fossil, and of the natural size, employing a side light the better to exhibit details, without resorting to diagrammatic treatment, and without colour to avoid that misrepresentation of solid form which attends every photographic rendering of coloured objects. I have also made an outline index to the drawing, which my friend and talented pupil, Mr. Kerr, has kindly executed in anastatic ink. (See Plate 10.)

'The specimen was given to Mr. Wilson by Mr. H. N. Hutchinson, (late Rugbeian), who had obtained it from Mr. Maude, who is able to trace it as far as Bangor, where it was given him by a workman. Nothing more is known of the locality of the specimen.

'Mr. Wilson, who has furnished a few particulars of the history of the specimen and the species, says, "It appears to be an extremely fine, and perhaps, at present, unique specimen of Cruziana semiplicata of Salter, (*vide* mem. of Geol. Survey of Great Britain, vol. 3, plate 3). The species is remarkably obscure. It is confined to the Silurian strata, and to the more or less sandy deposits of those strata, and has been found in various parts of the world. It has been referred to the Articulata and to plants: and Salter has sug-

gested that it may be a worm-tube, or burrow." I will now give the substance of my notes.

'One side of the slab presents five distinctly marked specimens, and a very small portion of a sixth which is not so distinct; and possibly a detached fragment of a seventh. The other side of the slab exhibits no actual specimen, but only a part of the print of one.

'The outline of each specimen may be characterized as strap-shaped, without any natural or unbroken extremities.

'The specimens lie partly imbedded in the slab, partly relieved from its surface. Each may be divided into, 1st, a more or less sulcated mesial line, which generally occupies a higher level than the slab itself; 2nd, two symmetrical and laterally convex surfaces that rise on either side of the cental furrow, and then more gradually descend to meet abruptly (3rd) two raised flattened cordiform margins whose inner edges, mostly the higher, are very seldom on so high a level as the highest part of the convexities just described, though occasionally higher than the central furrow. The width of one of these margins or parietes averages about $\frac{1}{16}$ of the entire width. They are sometimes longitudinally divisible into two or even three strips, as at E. (*vide* Plates 1 and 10.)

'Entire width, 2".

'Greatest elevation from the slab, 3'''.

'The two convex surfaces* are overspread partly—sometimes wholly—by more or less fasciculated fibres, that seem to arise from the mesial furrow, whence they always diverge, taking an oblique, outward, and curved course towards the margin. These *look* flexile and even fluctuating: that they must indeed have been so, is to some extent indicated by the fact of the most horizontal (F) of these fibres reaching the parietes, while the most vertical (G) fall farthest short of doing this. Their curved and flexuous form adds something to this evidence.

'If we regard these fibres as diverging upwardly, their curvature is convex above. One's first impression is, that they are branched (H, H, H): but although this is the matured opinion of some high authorities, I have not yet been able to detect one case of apparent ramification, that may not be interpreted as the mere under- or overlying of once fluctuating fibres subsequently compressed: and I have convinced myself of this by examining such appearance under different and opposite directions of light, by which a line of shade has always been thrown across the point of assumed bifurcation.

'And, again, it always happens, where you observe a fibre become bifid, that another fibre has abruptly disappeared, and this in a direction suspiciously continuous with one of the assumed divisions. Lastly, the supposed ramification is never found quite in the same plane with its trunk, but is ever accompanied by an increased elevation such as would attend the least amount of over-lying.

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* Mr. Wilson has remarked that the surface in which the fibres lie is more or less fibrous and punctated in appearance. I observed and drew, but omitted to describe, this appearance.

'*Relation of the Specimens.* Let us suppose the divergence of the fibres to be in an upward direction; then the largest of the specimens (1), 2″ wide, runs up the centre of the slab nearly vertically.

'This (1) is crossed near the top by the smallest specimen (5), 7‴ wide, which runs a little downwards, but nearly horizontally to the right, extending quite across the slab.

'A little above the middle of the largest, (1), and apparently rising out of it, a third specimen (2) runs obliquely downwards to the left, terminating with the edge of the slab at the beginning of its lower third. This is next in magnitude to 1, and is 1″ 10‴ in width. Somewhat to the right of the point at which the lower margin of specimen (2) reaches the slab's edge, there emerges from the surface a fourth specimen (3), which crosses (apparently) over 2 in an upward and oblique direction to the left, where it almost immediately becomes obliterated. It is a little smaller than 2; width, 1″ 9‴.

'Just half-way up the left hand side of the slab, at a salient angle, a fifth specimen (4) begins to take an upward course obliquely to the right, and nearly parallel to the last, (though running in an opposite direction in reference to the divergence of fibres). It soon becomes obliterated, but reappears at the slab's upper fourth and crosses the smallest specimen (5) close to its commencement, at the left hand upper angle of the slab. This is decidedly smaller than (3); width, 1″ 6‴.

'Part of a sixth specimen (6) begins at the slab's edge, close to the confluence of (2) and (3), runs horizontally to the right, a distance of 8‴, and is lost near the upper edge of (2). This is not very distinct.

'Thus no specimen in this slab is discrete. No. 1 is in contact with No. 2 and No. 5; No. 2 is in contact with No. 1, No. 3, and No. 6; No. 4 is in contact with No. 5; and No. 5 with No. 4 and No. 1.

'*Points of Contact.* Although these have been interpreted as the contact of mere superposition, a patient and somewhat prolonged examination would seem to point to an opposite conclusion.

'Reasons for this conclusion. 1st. No. 5 appears at its commencement to lie upon No. 1, but its actual superposition is limited to one-third of the width of the latter specimen. At this point it disappears, and does not reappear until we reach the opposite margin, where it abruptly comes into view. Therefore, to support the hypothesis of superposition, we must further hypothesize that the non-apparent portion has been removed by accident. But precisely the same thing happens where, a few inches to the left, the same specimen appears superimposed upon No. 4. It overlies No. 4 to a very small extent, and suddenly disappears as before. In this case it reappears in a shattered condition, but not till more than the width of No. 4 has been traversed.

'Again, No. 3 appears to overlie No. 2, but a closer examination shows that part of No. 2 actually overlies No. 3, then unaccountably vanishes, yet reappears as soon as the width of No. 3

has been traversed. Thus in three cases, on the same slab, we are called upon to frame an hypothesis of accident producing the same definite and particular results.

'The only other case of contact, or superposition, is where No. 2 overlies No. 1, at D; and here no vestige of superposition exists beyond the mesial line of No. 1. But as here there appear some signs of fracture and an abrupt change of elevation, this may be a veritable case of superposition. Of this hereafter.

'2nd. The hypothesis of superposition is arbitrary, inasmuch as, both specimens being partially obliterated at the point of contact, we may suppose either of them to be uppermost.

'3rd. An inspection of details leads to a more satisfactory solution. For it will be found that, in all three cases, where one specimen partly overlies another, and suddenly disappears, the overlying specimen shows no symptom of disruption—no fractured or elevated edge—but plunges into (and under the fasciculi of) the specimen whose margin it has so far crossed, and thus passing behind the pierced specimen, it reappears in due course. (Examine and compare points of perforation A, B, C.) But if one individual were capable of piercing or passing through another in this very definite manner—for the point of immergence is in all three cases just between the margin and the mesial line—it would be *à priori* probable that there would be a precise and definite adaptation of means, that the perforating object would present itself in a special and definite manner to the object it is adapted to perforate. It is not a little remarkable that this is the case.

'It must be remembered that, be these individuals vegetable or animal, they (at present) possess no polar distinction saving in the direction of the diverging of their fibres, which is never reversed in the same specimen. The fibres, for instance, of No. 1 always diverge in an upward direction; those of No. 2 in a downward direction; and so of all the rest.

'So that, although we cannot affirm which is the upper and which the lower extremity, we can yet recognise this polar distinction. We are then, *à priori*, to expect the perforating specimen to present itself to the object it perforates under one and the same polar aspect. Now, if in the three instances of contact cited we examine the direction of the divergence in question, it will be found that where one specimen plunges into the substance of another, its fibres are always presented in a divergent direction. (Compare points A, B, and C.)

'It must, notwithstanding, be borne in mind that what, from our point of view, as we regard the slab, is a point of *immergence*, may as well be a point of *emergence:* in which case it would be a convergent direction of fibres that would be presented in the act of perforation.

'Now in respect to the point of contact (D) where No. 2 appears to lie partly upon No. 1, it is extremely difficult, if not impossible, to arrive at any exact conclusion. It differs widely

from the three points cited in the fact of its nowhere exhibiting an immergence of its parietes, as at A and B, or of its fibres, as at C, within the substance of the contiguous specimen: neither, as in these cases, does the specimen undoubtedly reappear at the opposite margin. There is, however, one of those vermiform elevations (V), with which the slab abounds, in a direction sufficiently well answering to the previous course of the specimen, which might be taken for the emergence of its lower cordiform margin; but there is no vestige of fibres or fasciculi in the neighbourhood. Then it presents a somewhat abruptly terminated elevation, so considerable as to suggest the possibility of accidental disruption at this point.

'So, on the whole, I feel disposed to regard this either as a case of genuine superposition interrupted by transverse fracture, or else as a case of perforation commencing at the *under* surface of specimen (1), whose upper and visible surface would thus be bulged by the upward thrust in a vertical direction, while its fibres would be so carried along and mingled with those of the perforating specimen that the point of emergence would be both obscured and elevated at once. The vermiform trace referred to would then answer quite as efficiently for the *immerging* lower margin of specimen (2), as it would for the *emergence* of the same part.

'However this be, it is important to notice that the part of specimen 1 which would, according to this view, be the point of emergence, is in fact very much uplifted, together with specimen (2), so that the plane of its left-hand fasciculi makes a very observable angle with that of the fasciculi on the right. Moreover, since writing the above, I have clearly demonstrated a fractured surface (X), nearly at right angles with V, the figure of which strongly resembles that of the verified section of No. 1, &c. It would thus be almost certain that this is the section of specimen (2), and, this being so, there would be no possibility of the entire superposition of (2) above (1.) In short, this additional evidence is so powerful that I believe the mystery involving the contact of (1) and (2) is now cleared up, and that a successful removal of surface crust between (1) and X, V, would reveal the required fibres so as to establish the fact of (2) piercing (1) at its lower surface and emerging at D. Still this is merely opinion, and must remain such till more direct evidence arrives. Some further indirect evidence, however, will be adduced when we have examined the

'*Transverse Sections*. A very perfect transverse section of specimen (1) is found at its lowest part, Y.

'It is composed of at least two substances, a cortical and a medullary, the latter being decidedly lighter in colour than the former. There are also some faint traces of a difference of structure: that of the medullary portion suggesting the idea of tubes in section, while that of the cortical portion would seem rather fibrous. But whether this latter distinction be well or ill founded, the fact of a boundary line between a central or medullary

and a peripheral or cortical substance, is beyond doubt established not only by the sufficiently well-marked difference of colour already noticed, but more emphatically by an obvious difference of level, the cortical standing up around the medullary substance, and thus giving the latter a sunken or contracted appearance.

'There are likewise two sectional ends of (4,4), and a less perfect section of (2), betraying, more or less, the same characteristics. The upper end section of specimen (1) is unfortunately very imperfect.

'But these four transverse sections are enough to furnish the means of identifying other similar ones.

'Let us now advert to specimen (3). It is obliterated a little above its confluence with (2). There is, nevertheless, a raised surface running in the same continued direction, and apparently plunging into the lower side of (4,4) a little above its margin, *i.e.* at a line agreeing with the usual point of immergence, whilst, again, a raised surface, having the same trend, emerges on the opposite and upper side of (4,4,) till it terminates with the slab's edge. Now, on looking here for the transverse section of the obliterated but presumed subjacent part of (3,3), it is very distinctly appreciable (z).

'We thus prove five points of contact (instead of four), four of which exhibit peculiar and uniform conditions of perforation. There is thus an increased probability that the doubtful point D is not an exception to the rule. But by far the most weighty evidence to this effect is the fact of the mesial line being apparently pushed on one side at the presumed point of emergence, and pushed to that side toward which a body entering from behind would force it.

'If I have not described the "fragment of a seventh specimen," doubtfully alluded to at starting, it is because this (No. 7 of the diagram) is much less distinct than the others in consequence of its extremely fragmentary condition. Only part of one margin and a few fibres are present, the slab's right hand upper angle and adjoining right hand edge coinciding with the fractured boundary of the specimen. Still what remains of it exhibits signs of its being pierced by specimen (5), just in the same manner as (4) and (1) have been pierced. We shall thus have six examples of one peculiar and definite mode of perforation on this small field.

'Finally, though I cannot conjecture the nature of the living thing, animal or vegetable, which corresponded or gave occasion to this fossil, I should feel the time that has been devoted to the observing and delineating each fibre, and almost each granule of its surface, had been laboriously spent if it had left no impression on my mind. The first general impression is, that a certain appearance of rhythmus and resiliency, which characterizes every specimen, is an exponent of animal life, and, I believe, of muscular contractility. My next impression is, that feet, cilia, or other organs excavating sand, hard or soft, could not produce a matrix that would turn out a cast such as this, with its decussating, interwoven fibres proceeding gracefully, and often unbroken, from their central source. For although a succession of footprints at certain

intervals may produce good casts, a continuous succession of moving extremities must more or less obliterate one another's vestiges. Grant that the most elevated fibres are casts of the hindmost and thus least disturbed footprints; still the shallower prints of the preceding feet would necessarily be disturbed and disrupted at their edges by being thus scraped, stampt, or cut across. There would be what castors call a *burr*; and I doubt, from practical experience, whether such scraping or stamping even in wax would produce the clean casting we have in many of these fibres.

'These convictions, established by daily observation during several months, are still no more than convictions. They favour the supposition that the objects are fossilized animal structure; not prints, tracks, or casts made by the silting in of burrows, or tracks. In the discussion which followed the reading of this paper, Mr. Woodward, Professor Seeley, and others, still advocated the old hypothesis of *tracks*, while Mr. Hicks and the President held that the paper contained evidence to favour the opposite decision. If I am asked, what animals can thus pass through each other? I avow my absolute incapacity to answer. I only point to the fact that the objects, casts or not casts, pass through each other on the slab. The knowledge of such creatures may come. Certain it is, the knowledge of *what* creatures produced the required burrows has not come, seeing that, of such authorities as Mr. Woodward and Professor Seeley, the former as confidently affirms as the latter emphatically denies that the required creatures are trilobites.

'I feel, with Mr. Wilson, that in our present state of doubt, a transcript of the fossil registering every characteristic, and enabling those who may never see the specimen to investigate it by aid of photographs, is the best contribution I can offer, and I will conclude with two suggestions.

'1st. Will the hypothesis of burrows account for a cortical and medullary distinction of structure?

'2nd. What are the probabilities of, say, five of our existing Lug-worms by chance striking into each other's burrows at identically similar points, within a compass of two square feet?'

Mr. S. Haslam (c) read the following paper on '*Aquarium-keeping*.'

'A mere omniumgatherum of fishes, newts, tadpoles, and caddis-grubs, is not an aquarium. A collection of fresh-water life, to be worthy of the name of an aquarium, should be, *must* be, self-supporting in every possible way; and that it *can* be so, and *how* it can be so, is what I wish to shew you. The only way to ensure the greatest amount of success and pleasure and instruction is to follow Nature as far as we possibly can. The first thing to think about, therefore, is what to keep your fishes, &c., in; the next is how best to fit it and furnish it for fish-life; and thirdly,

how to keep it fit and furnished with as little human interference as possible.

'First, what to keep the fresh-water life in? The answer to this I get as follows. What suits the fish, &c., best?—A shallow pool. What best suits our purpose of observing them, with a view to our own pleasure and instruction?—A glass vessel. What we want, then, is a shallow tank either all glass or partly glazed. But as we must follow Nature as far as we can, and as Nature does not expose her aquaria to the light on all sides, *we* must also manage with as little side-light as we can. Very strong reasons for this will also appear when we come to consider how to do with as little interference as possible. The best kinds of vessels for aquaria are two. 1st and cheapest, an inverted bell glass with the knob inserted in a flat wooden stand, slightly hollowed to receive the upper curve of the dome. A little wet plaster of Paris will secure your glass into this firmly, but the side nearest the light of such a vessel had better be covered with dark green tissue paper. 2nd, a rectangular tank with the front and sides glazed; meaning by the front the face turned towards the room. The back should be slate, or if glazed should be covered with green paper as before described. The glass *must* be plate glass for this kind of aquarium, and the joints perfectly water-tight. You must, finally, take care that no metal is exposed to the action of the water, or your specimens will suffer.

'Now let us consider how best to fit and furnish your vessel for fish-life. Let us consider what we want. A place to keep fish and other fresh-water creatures in, so that they shall live as natural and healthy a life as possible. Let us then follow Nature again. We find in natural pools and streams, soil of different kinds, sand, mud, gravel and so on: it is our object to keep *our* pool as clear and clean as possible; we find in Nature that the clearest streams and pools have a gravelly bottom. Select therefore gravel for your soil. (You can get very good gravel, which comes, I think, from the river Trent, at Alcott's, the stone mason's, in Warwick Street, opposite St. Matthew's Church.) Wash this well two or three times, and then it will be quite ready to put into your aquarium as soil for the bottom. What else do we find in natural pools? Weeds, so called—that is, water plants, and a sort of green moss of various kinds. These are of the greatest use: they keep the water fresh enough for fish to live healthily in. They are, in fact, absolutely necessary to make the aquarium what an aquarium should be, self-supporting. Let us see what happens without them:—and here you must take my experience and that of others, if you have none of your own. Put your fish into your vessel without weeds, and they will, though a little scared, seem to live healthily enough at first: but in about a day's time you will see them labouring heavily to breathe and now then coming up to the top of the water to get a gulp of atmospheric air. This is not natural. Fishes, as you doubtless know, breathe, so to speak, through their gills, which are the slits on each side of

their head, which you see constantly opening and shutting. These gills are the means by which the fish extracts from the water oxygen, the fuel which keeps its blood in circulation and itself alive, gulping it in at the mouth and returning it through gills as carbonic acid. But water has only a limited amount of oxygen which *can* be thus extracted. And when this begins to get exhausted, the fish begins to lose its life-power and gradually dies, as surely as you or I would die if confined in a hermetically sealed room, of suffocation, the water being overcharged with carbonic acid. Or else, to avoid this, you must change the water in your so-called aquarium once or twice or oftener in a week. And then your aquarium is no aquarium: it is no longer self-supporting. Now let us try the effect of a few weeds. We shall find now, as I have practically found, that even if the water is not changed for *months*, the fish live perfectly well. Why is this?—Because plants require *carbon* for their sustenance, and this they get from the *carbonic acid* returned to the water by the fishes, separating the carbonic acid into its component parts, carbon and oxygen, assimilating the carbon and returning the oxygen or nearly all of it to the water. Part of this process you will see any day that the sun shines on your aquarium; you will see numberless little bubbles studding the leaves of your plants, or bubbling up in streams from their joints or any projecting point. These bubbles are oxygen gas, and as they stand on the leaves or go up in streams from the joints they are partly taken in by the water, and once more the water gets enough oxygen to support fish life. And so the circle is so far complete:—fishes absorbing the oxygen and leaving a feast of carbonic acid for the plants, the plants taking this in and returning oxygen to the fishes in their turn. There are many other things you will find in natural pools and streams which all serve their various purposes, and all help to make and keep this circle of life complete. You will find a green moss or confervoid growth of various kinds: this grows most where plants cannot grow, and where the water is most stagnant. It is a vegetable growth, and acts as the plants do, supplying oxygen to the water almost more abundantly than they do. You will find snails, and other shell life, which feed on the plants and decayed vegetable tissues, serving thus to keep down the excessive growth of the plants and acting as scavengers to prevent the decayed vegetable matter from poisoning the water;—these too supply food to the fishes in the shape of their eggs. You will find shrimps and other forms of crustacean life which act as universal scavengers, detecting at once the presence of any dead animal or vegetable substance and swarming on it and devouring it;—the shrimps too are most excellent food for the fishes. Under this head, roughly speaking, I would class for the sake of brevity all water beetles and their larvæ, and the other larvæ of flies, &c., that inhabit the water;—they are excellent scavengers, and capital food for the fishes. As for the more minute forms of animal life in water, their name is legion; and they do excellent service in the same way, eating up the waste of animal and vegetable life, and being eaten in their turn by the fishes.

'Now to our third consideration, for there is but an indistinct line between the second and third. How to keep the aquarium fit and furnished with as little interference as possible? Keep the balance between all these component parts of an aquarium as well and constantly established as possible. If you have too many fish, the plants will not supply sufficient oxygen and the fishes will die, or else the green confervoid growth will become excessive. If you have too many plants, they will rot and decay too fast for your scavengers, and then the water will get bad and your animal life will suffer. If you have too many scavengers, they will eat the living life instead of the dead, or eat one another, or anything that comes handy; and thus again you find your aquarium self-destroying and not self-supporting. Under this head come, then, all questions of how much or how many. How many fish to have?—About one to each gallon of water up to ten gallons—after that one to each three gallons. That is my answer from experience, and my experience dates back to the time when I was at school here, about the year 1860. How many plants?—Impossible to say accurately, or anything like. It depends on the size of the base of your aquarium; the nearest I can say is, about a plant to every square three or four inches; but you can always make up for plants, which are most of them somewhat unsatisfactory subjects, by encouraging on certain parts of your aquarium the growth of mosses and confervæ and such like. They *will* grow somewhere, do what you will, and the more sunlight you let in at the sides the faster and more furiously will they grow. This is what I call a very strong reason for having as little side-light as possible. You will have to keep the front glass constantly clear of this growth by using a sponge well and firmly whipped on to a stiff rod; and if you have all glass sides to you aquarium, you will do wisely to let it grow as it will everywhere else. Snails, especially of some kinds, will keep it fairly under for some time, but in the end it always beats them. It *looks* unsightly, I know, but it does good both by keeping out the sunlight in excess, and by aerating the water. It is for this reason of unsightliness that I recommend you to have the back and sides, or at any rate the back, of your aquarium rendered opaque. How many snails?—Here again I cannot give you anything like a definite answer. There are snails and snails. You may have almost as many of some sorts as you choose, or as you can get. The best kinds are three in number and are the rarest. They are called—

'1. Planorbis corneus. This is a largish snail when full-sized, being about the diameter of a bronze penny sometimes. The shell is very like that of a plain ammonite, a simple whorl, and of a dark black or bronze colour; about a third of an inch thick. I used to find them oftenest in the canal at Newbold, just beyond Walker's limepits.

'2. Planorbis carinatus. The same sort of snail and shell, only much smaller and with a keel or edge running round the outer circumference, rather to one side. Commoner than Planorbis corneus, according to my experience.

'3. Paludina vivipara. A most interesting snail, because, as its name implies, it produces its young not in the form of an egg, but in that of a real living and moving, however tiny, snail. Its shell is something like that of some common garden snails, being ornamented with lines running in the direction of the spiral; and it has a very distinct horny door-plate on a hinge, which it employs to shut the opening of its shell.

'These three are the best shells to have, and you may use a great many of them if you can get them; but, as I said before, they are somewhat rare, especially the last named. Do not have many shrimps and larvæ of beetles and caddis grubs at one time. It is best to get the larvæ when you can, keep them in a separate vessel, and put in one or two or three at a time. They should be fed when in a separate vessel with small shreds of meat, or small worms or insects with soft bodies. Shrimps, you should get a few at a time, 20 or 30, and put them in about once or twice a week. If you get a great number, as I once did, thinking they were very useful, they die in a day. In any case they don't live long in standing water, and if you have minnows or sticklebacks in your aquarium they make very short work with all but one or two of the shrimps. Never have more than five or six caddis grubs at a time in your aquarium: they are fearfully destructive to the plants, gnawing and eating the living leaves, it would almost seem, for mischief's sake. By all means get a crayfish, or even two; they are splendid scavengers, and most interesting to keep and watch. I once had three in an aquarium 15 inches in diameter (a bell glass) and 1 foot high. They lived until the aquarium was disestablished by my leaving Rugby: and I shall never forget my feelings when I came one morning after 1st lesson to look at my aquarium and saw four crayfish, and two of them on their backs seemingly as dead as doornails, and (to my amazement) a second look revealed two more, making six in all. How, in the name of Fortune, had my crayfish doubled themselves? Presently I noticed a fish dart by one, and then I saw it turn lightly over and lie on its back, dead to all appearance. Then the solution to the mystery dawned on me. The original three had all with one consent cast their skins in the night: and most beautifully they had done it; every leg, antenna and whisker as perfect in the discarded skin as in the living animal, *only*—empty. Do not get *bivalves*, or at least only the small "Cyclas corneum," and only one or two of him. They die easily these bivalves, especially the fresh-water mussels and such like; and then they smell so bad that even the shrimps won't eat them, and they get transformed almost into the quintescence of sulphuretted hydrogen, if there be such a thing. So *experto crede*, and eschew bivalves except Cyclas corneum. This is a small frail-looking fellow, like a couple of finger-nails hinged together with an oyster-like animal inside. His mode of progression is curious; like that of a cockle something. He puts out a sort of tongue shaped like a tiny soft baby's foot, and pushes himself about until

he wants to come to anchor or to burrow, and then he thrusts this into some soft place or some crevice in the soil and sways backwards and forwards edgeways, gradually wedging himself downwards. He is a scavenger more or less and acts as a sort of filter, being provided with a siphon and ciliated gills, by means of which he strains off from the water much of the decomposed matter held in suspension in it. One, two, or three cyclades are enough, because they are frail-lived creatures at best. And this reminds me to warn you that with *one* aquarium only, you cannot expect to keep all possible fresh-water animals. Some are such deadly enemies to others that you would soon have a battle royal going on. I will therefore now enumerate some of the commonest creatures to be found in fresh water, that can with anything like safety be kept together. And I will give you a few names of water plants which will do best in an aquarium: but flowering water plants must be employed cautiously, and as soon as they give signs of definite decay, up with them and throw them away. You will generally find that some of them have dropped seeds, and next spring these seeds will spring up. There are very few plants whose roots it is worth while to leave all the year round in an aquarium.'

There was no time for the rest of this interesting Paper, which was accordingly deferred until the ensuing Term, and will appear in our next year's report.

Dr. Mackenzie (c) read an interesting paper on the '*Ornithorhynchus Paradoxus*,' exhibiting a stuffed specimen.

REPORT OF SECTIONS FOR 1875.

Meteorological Section.

In drawing up the observations for the last year one alteration has been made. The difference only between the readings of the wet and dry bulb thermometers has been printed instead of the readings themselves, thereby saving a long column of figures, and at the same time recording the only fact that is really of special importance.

Last year, as every one knows, was remarkable for the excessive amount of rain that fell, and it may be interesting just to point out one or two facts connected with our Rugby rainfall.

The average rainfall at Rugby for the eight years from 1855 to 1862, as given by Mr. Fuller, was 22·577 inches: for the eighteen years from 1855 to 1872 it was rather higher, 23·88.

The fall of last year was 35·78 inches. In 1874 it was 21·54, in 1873—21·56, and in 1872—36·25: but although more rain actually fell in 1872 than in 1875, there was nothing in 1872 to compare with the excessive rain of last July, when the fall for the month was 7·58 inches. In October it was 5·87, and in November 4·34, and the total fall for the last six months of the year was 23·45, about the amount that ordinarily falls in the whole year.

The days on which more than 1 inch of rain fell were June 29th (1·04), July 15th (1·05), July 21st (1·65), October 9th (2·24), and November 13th (1·14).

As 1872 and 1875 stand preeminently the years of heaviest rainfall since 1866, it may be worth while to give the monthly totals of the two years in parallel columns.

	1872.	1875.
Jan.	3·84	3·16
Feb.	2·27	1·27
March	1·15	·62
April	2·51	1·54
May	2·18	1·76
June	4·30	3·98
July	4·34	7·58
August	2·99	1·16
Sept.	1·61	3·38
Oct.	3·02	5·87
Nov.	4·74	4·34
Dec.	3·30	1·12
Total	36·25	35·78

There has sometimes been a difficulty in obtaining volunteers to take the monthly observations during the last year.

When these observations were first commenced in 1871, the difficulty lay rather in finding occupation for those who wished to keep than in finding keepers, and several shewed so much zeal and interest in the work, that they were, after a time, rewarded by being raised to the rank of full Members of the Society instead of only Associates.

I should be glad to see something of this spirit during the present year.

Whatever slight amount of self-denial it may involve in going to look at the instruments after First Lesson instead of rushing off instantly to breakfast, there can be no doubt that it is a real gain to learn to take any instrumental observations with care and accuracy, to say nothing of the satisfaction that may lawfully be felt in the consciousness of taking part in a useful and important work.

T. N. Hutchinson.

Meteorological Observations.

January.

Date			Temperature Max.	Temperature Min.	Rain Inchs.
14	29,970	1,0		44	0,07
15	29,850	1,8		47	0,07
16	29,607	1,2		42,2	0,24
17	29,692	0,6		41,6	0,13
18			Incorrectly returned.	42	0,05
19				45,2	0,11
20				44,8	0,26
21				36	0,04
22				28,8	0,17
23				32	0,36
24	29,104	3,0		36	0,10
25	29,175	1,6		38	[illegible]
26	30,123	0,6		34	0,09
27	30,172	0,0		35	trace
28	30,161	2,0		41,8	0,02
29	30,287	0,2		43	0,38
30	30,577	1,8		35,8	
31	30,556	1,0		31,2	
Average	29,892				Total 3,16

February.

Date			Temperature Max.	Temperature Min.	Rain Inchs.
1	30,367	1,2	Out of order.	33,5	[illegible]
2	30,245	0,5		35	trace
3	29,945	0,4		34,5	
4	30,040	0,7		27,0	
5	30,373	0,4		26,0	
6	30,344	0,5		25,5	,07
7	30,154	0,2		34,0	,06
8	30,236	0,2		27,8	
9	30,181	0,0		24,1	
10	30,208	0,0		30,2	
11	30,159	0,3		29,5	,21
12	29,841	0,2	43	34	,04
13	30,151	0,2	49,4	38	,04
14	29,978	1,1	49,2	45,4	,09
15	30,271	0,4	53,0	29	trace
16	30,530	0,0	48,7	30,6	,04
17	30,337	1,5	44,3	36,6	,02
18	30,310	1,0	41	38,2	,02
19	30,269	0,3	40,5	29,2	,24
20	30,198	0,0	33	28,1	,14
21	30,217	0,1	41,6	29,0	
22	30,253	0,2	41	24,2	
23	29,952	0,2	42	26	
24	29,409	0,0	[illegible]	27,9	,24
25	29,465	0,3	33	32	,04
26	29,567	0,0	36,2	33	,02
27	29,700	[illegible]	42	30	trace
28	29,845	0,0	31	28,3	
Average	30,090				Total 1,27

March.

Date	Barom. Re-duced.	Temperature Diff. of Bulbs.	Max.	Min.	Rain — Inchs.	Date	Barom. Re-duced.	Temperature Diff. of Bulbs.	Max.	Min.	Rain — Inchs.
1	29,852	0,1	30,5	28,4	0,06	18	30,651	0,6	43,8	25,1	0,03
2	29,934	0,0	33,1	29,2	0,02	19	30,174	0,2	45,5	34,4	trace
3	29,945	0,0	32,6	30,8		20	30,178	1,2	47,1	33,8	
4	30,052	0,0	35,3	27,2		21	30,200	1,9	42,2	29,6	0,01
5	29,996	0,0	37,8	26	0,03	22	30,096	0,2	44,9	33,4	trace
6	29,754	0,3	40	33,1	0,22	23	30,358	1,7	49,8	36	
7	29,815	0,3	49,8	45	0,20	24	29,540	2,0	45,8	38	
8	30,026	1,8	55,3	46		25	30,353	2,5	50,8	38	
9	29,873	1,6	57,1	47,1		26	30,195	2,0	52	43	
10	30,450	0,2	error	52,8		27	30,062	4,0	52,4	35,2	0,05
11	30,363	0,3	error	53,6	trace	28	30,096	2,4	53	33,2	
12	30,060	0,8	53,5	32,9	trace	29	30,477	3,0	47	34,6	
13	30,050	1,0	35,7	33,9	trace	30	30,499	1,4	48	41	
14	30,197	0,2	39,7	34,2		31	30,655	1,6	52	42,6	
15	30,234	0,5	44,8	32,6		Average					Total
16	30,301	0,2	44	27	trace						,62
17	30,332	0,6	43,5	34,2	trace						

April.

Date	Barom. Re-duced.	Temperature Diff. of Bulbs.	Max.	Min.	Rain — Inchs.	Date	Barom. Re-duced.	Temperature Diff. of Bulbs.	Max.	Min.	Rain — Inchs.
1	30,661	1,8	58,6	44,2		18	30,260	5,0	64	32	
2	30,563	4,0	54,2	39,2		19	30,274	7,2	65,8	35	
3	30,096	2,6	52,2	39	0,01	20	30,312	8,0	70,2	37,8	
4	29,791	6,2	57,8	42	0,13	21	30,036	9,0	72	41,6	0,21
5	29,282	2,2	57	43	0,13	22	30,027	2,6	61,8	37	trace
6	29,515	2,0	52	43	0,32	23	30,065	2,8	51,2	27,6	
7	29,455	1,2	54	37	0,41	24	30,319	4,6	51,8	35,6	
8	29,715	0,0	54,4	37	0,06	25	30,400	5,0	54	40,2	
9	30,047	1,0	43,2	36,4	0,25	26	30,291	6,6	58,2	36,6	
10	30,292	0,0	41,4	38	0,01	27	30,168	5,0	59	44	
11	30,378	1,6	45,8	37,8	trace	28	30,258	4,2	61,2	42	
12	30,304	0,0	48,8	38		29	30,276	6,0	68,8	41,6	
13	30,380	3,0	48,2	35,4		30	30,221	3,6	62,2	42,2	0,01
14	30,406	2,8	45,8	29							
15	30,497	1,8	58,8	34,6		Average	30,160				Total
16	30,465	2,4	58	32,2							1,54
17	30,355	5,4	56,8	36							

May.

Date	Barom. Re-duced.	Temperature Diff. of Bulbs.	Max.	Min.	Rain — Inchs.	Date	Barom. Re-duced.	Temperature Diff. of Bulbs.	Max.	Min.	Rain — Inchs.
1	29,951	7,5	65,5	45	trace	18	29,609	3,5	67,5	47,5	,21
2	29,978	0,5	51	48,5	trace	19	29,581	4,0	57	40	,05
3	29,945	5,0	58,5	40		20	29,720	3,0	59,5	42,5	,35
4	30,040	5,0	62	48		21	29,731	4,5	60	41,5	,11
5	30,000	4,0	65	47,5	,03	22	29,776	4,5	61	48	,11
6	29,775	1,5	62,5	44,5	,17	23	30,073	6,5	62,5	42,5	
7	29,516	6,0	64,5	46	,23	24	30,424	3,5	62	43	
8	29,798	1,5	58,5	49	,31	25	30,310	6,5	62,5	43	trace
9	29,845	3,0	63	.45	trace	26	30,296	5,5	62	41	
10	30,121	5,0	65	48		27	30,280	1,0	59,5	48,5	
11	30,396	2,5	63	41		28	29,897	5,5	62	41	,19
12	30,338	5,0	66	45		29	29,883	3,5	62,5	43	
13	30,311	3,5	73	48,5		30	29,975	7,0	57,5	37	
14	30,303	4,5	73	44,5		31	30,062	0,5	75	45	
15	30,169	2,5	71	53		Average					Total
16	30,291	4,5	78,5	41			30,019				1,76
17	30,120	4,5	69,5	40	trace						

June.

Date	Barom. Reduced.	Temperature Diff. of Bulbs.	Max.	Min.	Rain Inchs.	Date	Barom. Reduced.	Temperature Diff. of Bulbs.	Max.	Min.	Rain Inchs.
1	30,217	0,0	67,9	41,0		18	30,039	0,8	61,1	49,5	,02
2	30,213	3,3	71,1	46,1		19	30,166	2,9	65,5	43,4	,05
3	[illegible]	3,6	74,0	46,0		20	29,962	0,6	68,9	54,0	
4	[illegible]	2,8	80,0	52,8		21	29,840	4,0	69,2	48,0	,04
5	[illegible]	4,8	77,0	45,5		22	30,148	4,0	67,1	42,7	
6	[illegible]	3,5	†	†		23	30,281	2,0	68,1	54,0	
7	[illegible]	3,3	†	†		24	30,245	5,3	70,1	49,2	trace
8	[illegible]	4,8	69,0	54,0		25	30,235	3,0	69,0	50,8	trace
9	[illegible]	5,5	72,0	50,0	,43	26	29,883	3,0	72,0	50,5	
10	[illegible]	5,0	64,1	?	,20	27	30,027	7,0	70,6	43,0	,22
11	[illegible]	4,0	63,0	46,5	,12	28	29,820	0,5	65,0	50,5	,85
12	[illegible]	3,5	61,0	44,3	,31	29	29,898	5,5	63,0	55,0	1,04
13	[illegible]	4,0	55,5	44,0	,30	30	29,840	0,5	64,0	53,5	
14	[illegible]	3,1	57,6	50,0	trace						
15	[illegible]	5,2	62,7	47,0	,24	Average					Total
16	[illegible]	3,3	61,0	48,3	trace		29,596				3,98
17	29,798	3,2	63,8	46,9	,16						

July.

Date	Barom. Reduced.	Diff. of Bulbs.	Max.	Min.	Rain Inchs.	Date	Barom. Reduced.	Diff. of Bulbs.	Max.	Min.	Rain Inchs.
1	29,755	2,5	61	51,6	,20	18	29,766	1,1	63	55,2	,04
2	29,699	3,0	69,5	54,8	,40	19	29,831	1,0	82,7	[illegible]	,60
3	29,908	0,5	68,5	52,1	,74	20	29,931	0,5	63,2	54	,80
4	30,321	1,5	57,5	50	,21	21	29,931	0,2	70,5	54,2	1,65
5	30,357	2,1	†	45		22	29,755	2,0	68,5	53,8	,36
6	30,351	2,0	†	50		23	29,677	5,5	68	54	trace
7	30,333	3,8	†	48		24	29,634	†	73,5	53	,20
8	30,055	3,7	†	53		25	29,912	5,0	69	44	trace
9	29,691	1,2	†	55	trace	26	30,297	3,8	69	43,5	trace
10	29,571	2,8	†	53,2	,42	27	30,387	5,0	69,5	45	
11	29,473	†	†	44,2	,10	28	30,357	3,6	71,2	49,8	
12	30,163	4,0	†	48,7	,41	[illegible]	30,353	5,8	74,4	57	
13	30,224	5,0	†	41,2	trace	30	30,159	2,6	77,8	56,6	
14	29,996	3,4	57,2	47,2		31	30,157	6,2	70,6	46,8	
15	29,667	1,0	67	50,2	1,05	Average					
16	29,909	4,0	63	52,8	,40						Total
17	29,951	1,0	67	52							7,57

August.

Date	Barom. Reduced.	Diff. of Bulbs.	Max.	Min.	Rain Inchs.	Date	Barom. Reduced.	Diff. of Bulbs.	Max.	Min.	Rain Inchs.
1	30,193	4,8	69,6	41,8		18	30,037	4,2	75,2	56,4	trace
2	30,265	5,0	69,6	44,4		19	30,197	3,4	72	50	
3	30,133	4,8	69,6	46	,20	20	30,222	3,6	72	49,4	
4	30,249	1,2	69,6	46,8	trace	21	30,350	6,2	74	46,6	
5	30,099	2,4	67	45	trace	22	30,235	4,0	72	49	
6	29,972	0,2	69	56	,07	23	30,105	3,4	74,4	49	
7	29,999	1,8	69	56	,01	24	29,886	2,8	72	48	trace
8	30,059	1,6	69	58,6	,01	25	29,829	3,4	70,6	57	,12
[illegible]	29,779	1,6	74,2	59		26	29,941	0,8	70,2	58,4	trace
10	29,791	3,8	70,4	56,2	,17	27	30,150	3,4	73	51,8	
11	29,848	0,2	70,4	58,8	,15	[illegible]	30,105	2,8	72,4	48,2	,13
12	29,821	0,2	72	58	,12	29	29,949	1,2	67	53	
13	29,805	1,8	69	56,6	,03	30	30,073	2,2	72	49	,08
14	30,035	1,6	72,6	57	,06	31	30,034	4,8	69	50,4	
15	30,162	0,8	75,2	59,8	,01	Average					
16	30,053	3,4	73,2	58							Total
17	29,985	2,4	82,8	53,6							1,16

† On the days marked thus the observations are untrustworthy, and are therefore omitted.

September.

Date	Barom. Re-duced.	Temperature Diff. of Bulbs.	Max.	Min.	Rain. — Inchs.	Date		Temperature lff.of ulbs.	Max.	Min.	Rain — Inchs.
1	30,271	4,0	66	42,4		18		0,2	73,6	54,4	
2	30,173	2,4	72	56	,11	19		2,2	75	52	,13
[redacted]	29,923	1,0	66	57	,25	20		†	78	55	,04
4	30,097	3,2	68	52		21		0,0	70,8	52,8	,95
5	30,251	3,0	68	52,8		22		0,0	66	57	,06
6	30,327	2,2	69	45,4	trace	23		1,8	61,4	49,6	,86
7	30,125	3,6	71,8	52	,02	24		1,0	53	50	,31
[redacted]	29,941	0,6	75	53,2	,08	25		2,2	63	53,6	,03
9	29,869	4,0	67	50,6		26		2,8	69	50	,02
10	29,958	2,4	67	48		27		4,6	64	47,6	,04
11	30,206	0,2	68,6	43,6	,01	[redacted]		2,4	60,4	49,2	,11
12	30,369	0,6	72	51,6		29		2,8	61,8	42,6	trace
13	30,297	2,0	60	55,2	trace	30		1,8	59	49	,06
14	30,279	†	74,6	55,4	trace						
15	30,229	2,0	70	53,6							Total
16	30,133	2,8	70,8	52,8	,26	Average	30,060				3,38
17	30,093	0,4	73,6	51,6	,04						

October.

Date	Barom.	Diff. of Bulbs.	Max.	Min.	Rain.	Date	Barom.	Diff. of Bulbs.	Max.	Min.	Rain.
1	29,945	1,0			,07	18	29,874	1,1			,35
2	29,725	1,5			†	[redacted]	29,765	0,5			,31
3	29,897	†			†	20	29,570	0,6			,93
4	29,710	†			,33	21	29,555	1,0			,19
5	29,910	2,0			,01	22	29,537	0,2			,05
6	30,349	3,7			trace	23	29,450	0,4			,01
7	30,330	3,3				24	29,992	1,2			
8	30,160	1,0				25	30,224	1,0			trace
9	29,686	1,9	No record.	No record.	2,24	26	30,098	1,3	No record.	No record.	,20
10	29,880	2,0			,33	27	29,782	0,2			,45
11	29,273	1,8			trace	28	29,932	1,0			,09
12	29,353	0,5			,01	29	30,109	0,5			trace
13	29,277	0,4			,01	30	30,024	1,4			
14	29,365	0,7			,07	31	29,918	1,7			
15	29,577	†			,21						
16	29,734	0,0			trace	Average	29,800				Total
17	29,809	1,0			,01						5,87

November.

Date	Barom.	Diff. of Bulbs.	Max.	Min.	Rain.	Date	Barom.	Diff. of Bulbs.	Max.	Min.	Rain.
1	29,923	1,3	44	37		18	30,057	2,3	54,8	52,3	,08
2	29,894	1,7	49	39	,10	19	29,638	4,5	60,8	49	trace
3	29,794	0,5	50	47,2	trace	20	30,094	3,6	50,5	33	
4	29,803	1,0	53,8	47	trace	21	30,061	1,4	39,1	29,9	trace
5	29,458	0,6	59	45	,71	22	30,249	0,8	43,6	34,8	trace
6	29,150	0,3	51	44,5	,19	23	30,291	0,8	43,2	34	,03
7	29,420	2,6	54,2	40,1	,24	24	30,256	0,8	42,5	36	,04
8	29,359	1,4	51	34		25	30,129	0,3	38	32,8	,02
9	29,462	0,8	46	28,3	,82	26	30,051	0,4	36	29,4	,01
10	28,723	0,5	47,4	41,2	,35	27	30,094	0,6	34,2	29,8	,06
11	29,135	1,3	43,2	36,4	trace	28	30,107	6,3	36,1	33,8	,02
12	29,810	1,0	43,5	36	,14	29	30,088	0,6	31,5	31,9	,03
13	29,732	0,4	51,6	36	1,14	30	30,002	1,3	35	30,8	
14	28,978	1,8	54	45	,07						
15	30,176	0,6	41	32,5	trace						Total
16	30,091	1,8	51	46,5	,19	Average	29,801				4,34
17	30,017	0,8	48,5	41,8	,10						

NOTE.—The rain entry for Oct. 4, is obviously the total rain for Oct. 2, 3, and 4.

December.

Date	Barom. Re-duced.	Temperature Diff. of Bulbs.	Max.	Min.	Rain — Inchs.	Date	Barom. Re-duced.	Temperature Diff. of Bulbs.	Max.	Min.	Rain — Inchs.
1	29,976	0,8	40,8	30		18	29,861	1,1	32,5	26,6	,04
2	29,901	†	37	34,5		19	29,646	1,3	37	31	,15
3	29,891	0,3	38,3	36	trace	20	29,673	2,5	35	30	
4	29,849	0,4	44	40,5	,01	21	29,879	2,9	34	29,7	trace
5	30,096	0,1	45,3	42	,01	22	29,587	3,0	34,2	26,5	,08
6	30,192	0,2	47,8	35,3	,09	23	30,028	1,8	32,8	22,5	,12
7	30,490	0,0	51,2	40,8	,13	24	30,125	2,0	32,3	27,9	
8	30,509	0,2	53,8	47	trace	25	30,364	2,2	34	31	trace
9	30,421	0,0	53,6	37,6	,07	26	30,433	0,4	35,9	28,9	,01
10	30,386	0,2	47,8	41,8	,06	27	30,441	0,8	36	31,5	,03
11	30,160	0,3	49,8	37	trace	28	30,513	1,2	40	37	,06
12	30,128	1,1	45,8	37	trace	29	30,413	1,2	42	36	,01
13	30,252	1,5	54	42	trace	30	30,299	0,6	49,2	37	
14	30,174	0,8	44	38		31	30,109	2,0	42,5	28,4	trace
15	30,189	0,3	43,6	41,2	trace	Average					
16	30,156	0,5	48	41	trace						Total
17	30,000	0,2	46,2	38	,25						1,12

Below are given the names of those who have assisted during the past year.

J. H. Ashwell
A. C. Bannister
R. C. Benson
G. W. Carter
H. M. Foster
R. S. Gunnery
H. N. Hutchinson
G. L. King
J. J. Mann
H. F. Newall
J. W. Nicholson
R. Oldham
A. J. Solly
W. B. Thornhill
H. W. Trott
W. S. Tindall
A. Wise
Mr. Kirk (during vacations)

Report on the Temple Observatory.

The instruments in use at the Temple Observatory are the same as those described in a previous report, with the addition of an astronomical clock. All the instruments are in good order.

The astronomical clock was purchased in March, 1875, from Mr. E. Crossley, of Halifax. It is a first-rate clock, and shews mean time on a small dial, as well as sidereal time on the principal dial. To protect it from the certainty of injury from damp in the Observatory, it is placed at present in Mr. Wilson's house, and is connected by a wire with a common clock in the Observatory, and regulates it by an electric current in the usual manner. The construction of this connection, and the necessary time observations for regulating the clocks taken on 61 different days, have been all undertaken and carried out by Mr. Seabroke. The mean rate of the clock for the last three weeks has been one-fifth of a second a day losing.

The measurement of double stars has been the principal work of the Observatory during the past year, as in previous years, and 303 have been measured. The number is somewhat smaller than that in

previous years, owing in part to the number of available nights being less, and in part to Mr. Wilson's unavoidable absence from the Observatory. The measures have been made entirely by Mr. Seabroke and Mr. Percy Smith.

Two papers by Mr. Wilson have been published in the Monthly Notices since our last report; on the relative rectilinear motion of the components of 61 Cygni; and on the period of the double star, η Coronæ Borealis.

Mr. Wilson also prepared for publication the whole of the measures of double stars taken at the Observatory in the years 1871, 2, 3, and 4, and the reduction of the places to the epoch 1880. These were communicated to the Astronomical Society, and have been published in vol. 42 of the "Memoirs." They consist of about 1150 sets of measures on distance and position of about 500 double and multiple stars. The measures of several former members of the School are included; those from whom the principal help was received are Messrs. Worthington, Maxwell, Houghton, and Larden. A copy of this publication is herewith presented to the Society.

The sun has been watched when possible, and 35 drawings of the chromosphere made. These observations have been recently undertaken at Greenwich also, with greater instrumental means. The mode of observation has been slightly varied from that adopted in previous years. The ring slit has been discarded, and a curved slit, turned to the curvature of the image of the sun, and admitting about 20° of its arc, has been substituted. By this change a greater magnifying power can be employed, and the observations are rendered somewhat more exact. All solar work has been done by Mr. Seabroke with the 12¼-in. reflector. Compared with previous years it is remarkable how very little disturbance there is in the chromosphere.

Owing to Mr. Wilson's enforced absence from the Observatory, the number of visitors from the School has been much less in this year than in previous years. There has been however a fair number of them. Drawings of Jupiter and Saturn have been frequently made. Mars has been too low for satisfactory observation: no clear outlines could be obtained.

Mr. Seabroke, after some preliminary trials on small discs of glass, has polished a plane 12-inch mirror for a siderostat; and he is now constructing the mounting to carry it, on Foucault's principle. When finished it is intended to use it for experiments on photographing the solar prominences. It has been found impossible in practice to mount the heavy spectroscopic and photographic apparatus, with sufficient rigidity, on a telescope equatorially mounted and driven by clock work: and the siderostat will therefore be employed to reflect the rays of the sun in a constant direction along the axis of a fixed telescope, so that the photographic and other apparatus can be fixed on a table in the Observatory. The difficulty, however, of making an optically perfect 12-inch plane mirror is very considerable, and other difficulties in the plan are not less formidable.

Mr. Percy Smith has undertaken a course of experiments with the hope of obtaining a medium, or series of media, transmitting only that portion of the solar spectrum which borders on the *C* line. If this can

be accomplished it will materially facilitate the observations of the chromosphere by the new method in course of preparation, by cutting off unnecessary and interfering light. By a combination of coloured solutions he has at present been enabled to transmit only the portion of the solar spectrum that lies between *B* and *C*, and has been therefore partially successful.

We must again call attention to the condition of the Observatory, and express our hope that the Governing Body will soon select a site for a more permanent building to be erected.

15 Feb. 1876.

J. M. Wilson.
G. M. Seabroke.

Entomological Section.

The work of this section was chiefly confined to the arrangement of the cabinet of Lepidoptera till the real season began: and we are glad to be enabled to announce that this great business is at last completed, and the cabinet ready for the reception of the new moths and butterflies, which we hope soon to see filling the empty spaces allotted for them. The labelling and preparing of the drawers has taken between two and three years of fairly continuous work, with the casual assistance of several members of the School, of whom we may especially notice H. Vicars, as having taken great interest in it from first to last. We are extremely sorry to miss him in the compilation of this section of our report, but he is unavoidably absent through illness.

But although so much has been done, a great deal more remains: the cabinet will require, in future, almost constant supervision, to prevent deterioration in the specimens we have already, quite apart from the numerous additions which we feel confident the coming season will bring with it. And this leads us to say that much remains to be done among those smaller families, the Tortrices and Tineæ, which are very poorly represented in our cabinet. They are very small, no doubt, and it is difficult to say what there is left of them when they have been pinned, but success is sure to attend honest endeavour. Of these families we have no reliable local list, which is a great desideratum, and one which we hope ere long to see supplied.

And, putting Lepidoptera aside, what hosts of other bug-like tribes demand a patient investigation. Coleoptera, Hymenoptera, Arachnidæ are crying out all around us for volunteers in the good work of catching and setting them. In short there is much to do, and not too many to do it: we will do all we can and hope for assistance. And before we pass on, we would notice how very few and far between the donations of specimens have been. What have our collectors been about?

But we have one subject of congratulation, which is our imposing list of appearances—a larger number than we have been able to print for a long time. And when we consider what a very little trouble it is to note down the day on which we caught that Death's Head, or saw, but failed to catch, that purple Emperor, it is really surprising that we have not usually a better list to shew. We hope in our next report to be able to give a comparative list shewing appearances and dates in two successive years.

List of Appearances.

N.B. † new species. A.S. A. Sidgwick. H.F.W. H.F.Wilson. ! denotes 'common.'
E.J.P. E. J. Power. C.B. C. Bayley.

June	1	Triphæna Pronuba ! !	
„	10	Rumia Cratægata	
,	17	†Acronycta Ligustri	C.B.
„	17	Grammesia Trilinea	C.B.
„	17	Cucullia Umbratica	A.S.
„	17	Noctua Plecta	C.B.
„	17	Phlogophora Meticulosa	C.B.
„	17	Caradrina Alsines !	
„	18	Agrotis Exclamationis ! !	
„	18	Xylophasia Polyodon ! !	
„	19	Axylia Putris	C.B.
„	19	Euplexia Lucipara	A.S.
„	19	†Leucania Comma	H.F.W.
„	19	†Hadena Oleracea	C.B.
„	19	Caradrina Blanda	
„	19	†Eupithecia Venosata	H.F.W.
„	19	Coremia Ferrugaria	C.B.
„	19	†Mamestra Anceps	H.F.W.
„	20	Acronycta Psi	
„	20	Melanippe Montanata	
„	21	Hepialus Humuli	C.B.
„	21	Chœrocampa Elpenor	C.B.
„	21	Mamestra Persicariæ	C.B.
„	21	Mania Typica	C.B.
„	24	Zygœna Filipendulæ ! !	E.J.P.
„	25	Herminia Tarsipennalis	C.B.
„	25	Cidaria Dotata	H.F.W.
„	25	Pionea Forficalis !	H.F.W.
„	26	Acidalia Imitaria	H.F.W.
„	26	Acidalia Aversata	H.F.W.
„	26	Melanippe Procellata	C.B.
„	27	Leucania Pallens	C.B.
„	30	Ourapteryx Sambucata	
„	30	†Noctua C. nigrum	H.F.W.
„	30	Xylophasia Lithoxylea	H.F.W.
July	1	†Noctua Augur	E.J.P.
„	2	Stilpnotia Salicis (bred) ! ! !	
„	3	Anaitis Plagiata (seen)	C.B.
„	3	Miana Fasciuncula	H.F.W.
„	4	Plusia Iota	C.B.
„	4	Cidaria Fulvata	C.B.
„	5	Trochilium Tipuliforme	C.B.
„	5	Aglossa Pinguinalis	H.F.W.
„	5	Agrotis Segetum	
„	7	Abraxas grassularirata	
„	8	Porthesia Chrysorrhœa	H.F.W.
„	10	Vanessa Polychloros (larvæ)†	H.F.W.
„	14	Boarmia Rhomboidaria	C.B.
„	16	Apamea Oculea	H.F.W.
„	19	Zygœna Lonicerœ	
„	19	Lasiocampa Quercus (bred)	
„	20	Odonestis Potatoria (bred)	

July 20 Clisiocampa Neustria (bred) . . .
„ 21 Plusia Chrysitis . . . . . . C.B.

One of the chief uses of a list of this sort is to determine the lateness or earliness of the season in which the insects were caught. For this purpose a record of common insects is more useful than of rare ones, as the common insects give greater opportunities of comparison in another season, while a rare one may not occur again for several years. We have therefore determined to draw up a list of common insects covering the entire year, that dates may be entered. Anyone may have one of these lists, printed separately, on applying to the President of the Society, and anyone who knows a white butterfly when he sees it is earnestly requested to apply at once. These lists, when filled up, will be compared, and will supply materials for valuable results in connection with the botanical lists of the same season.

List of Common Insects.

JANUARY.

P. Pilosaria

FEBRUARY.

T. Instabilis
T. Cruda

MARCH.

[SALLOW-BLOSSOM]
Tœniocampa (11 species)
B. Betularia
S. Illunaria

APRIL.

P. Brassicæ (cabbage white)
A. Cardamines (orange tip)
—„—
N. Plecta
R. Crataegata (brimstone moth)
M. Fluctuata

MAY.

L. Megæra
C. Pamphilus
C. Phleas (copper)
P. Alexis (blue)
—„—
H. Lupulinus
C. Vinula (puss)
P. Bucephala (buff-tip)
S. Menthastri
A. Psi
M. Brassicæ (cabbage moth)
P. Meticulosa (angle shades)
P. Gamma
Eupitheciæ (pugs) 22 species
M. Montanata

JUNE.

H. Janira (meadow brown)
V. Urticæ (tortoiseshell)
—„—
S. Ligustri (privet hawk)
H. Humuli (ghost moth)
X. Polyodon
Agrotes (9 species)
T. Pronuba (yellow underwing)
C. Fulvata

JULY.

P. Brassicæ (2)
P. Sylvanus (skipper)
—„—
O. Antiqua
A. Caia (tiger moth)
A. Oculea
Noctuæ (13 species)
C. Bilineata
M. Maura (old lady)

AUGUST.

G. Rhamni (brimstone)
V. Io (peacock)
—„—
P. Chrysorrhoea (golden tail)

SEPTEMBER.

G. Libatrix (herald)
P. Meticulosa (2)
R. Cratægata (2)

OCTOBER.

[IVY-BLOSSOM]

DECEMBER.

C. Brumata

N.B. The figure 2 placed after a name means that it is a second-brood.

The new species we have to notice are 7 in number, and are all members of the larger families: they are as follows:—

Acronycta Ligustri	C.B.
Leucania Comma	H.F.W.
Eupithecia Venosata . . .	H.F.W.
Hadena Oleracea	C.B.
Mamestra Anceps	H.F.W.
Noctua Augur	E.J.P.
Noctua C. Nigrum	H.F.W.

Also the larvæ of Polychloros, which has never, we believe, been bred in Rugby before. 8 were found in the Hillmorton Road.

We have also to confirm the appearance of Cucullia Umbratica, which has not been noticed for about 20 years. It was caught perched on the tape which was used for a lawn-tennis court in Mr. Wilson's garden, and had grown dirty from exposure to the atmosphere, and it so exactly matched the tape in colour as to be quite invisible a few yards away. [It should be noticed that our last report contains a full list of local species.]

We should naturally have inferred from the coldness of the early spring that it would be a late year for insects, but our list of appearances not beginning till June, it is impossible to collect any evidence bearing upon this point, as it would of course only influence the appearance of the early insects, and of these we have no record.

The floods in July, and the almost incessant rains of that month, would seem to have had but little effect on the appearances, if we may judge from the moths entered in our list, which have come out true to time, rain or no rain.

But it is impossible to make conjectural statements, without a list to compare with the one of this year: and unfortunately last year's list is so meagre as to render any comparison impossible. All we can gather is, that Euplexia Lucipara was first seen in 1874 on June 11th, while in 1875 it did not appear till the 19th.

We are glad to announce that, owing to the liberality of the subscribers, who refused to have their subscriptions returned when a surplus was found over from Mr. Kitchener's testimonial, a cabinet has been ordered for foreign lepidoptera, where the unhappy cripples who have tumbled about loose in wooden boxes for so long will at last find rest.

They will be arranged in it, without reference to locality, but in true cosmopolitan fashion, and it is hoped that we shall thus be able to form a collection which will be of real service to the Society.

To sum up, then, we want

(1) Help,
(2) Lists,
(3) Tineæ and Tortrices,
(4) Donations.

N.B. There is a larva-cage in Mr. Wilson's garden, where he has kindly allowed it to be placed, which will be ready in a few weeks for inmates. No cannibals (Satellitiæ, etc.) need apply.

H. F. W.

Geological Section.

Owing to various circumstances, of which the chief was Mr. Wilson's illness and enforced absence from Rugby, the Geological work has fallen through. The following notes are however important, and are therefore printed here in place of a general report.

Note on some Bones found in a Drift at Lawford, by J. M. Wilson.

'Early in February of this year, I had a message sent me by one of the workmen at the Lime works near the Bath between Lawford Mill and Newnham, that there were some bones and teeth being found in the clay. I walked there at once, with Mackenzie, and spent an afternoon with one of the workmen, digging. Shortly after this I was laid up with cold, and did not visit the pit again; but it was visited in my absence repeatedly by M. Firth (A), who brought me information as to what was going on. Again in April I went and brought back with me a large basketful of bones, being all that had up to that time been collected.

'On Plate 6, drawn by C. Kerr (M), a map of the district is shewn on a large scale. The spot where the bones were found is marked *A*. The exact identification of the spot is due to the observations of M. Firth (A), who kindly undertook this part of the work. The alteration of the ground by the excavations for lime is so great, that no mere verbal description is sufficient to identify the spot.

'The bones were found occupying an area of about 12 feet by 6 or 8; and at a depth of about 8 ft. below the surface. That is, they would have been all contained in a block 12 feet by 8 and 1 foot thick. The clay in which they were found did not differ appreciably from that which lay a few inches above or below. But at a foot below them there were marks of stratification, and the clay was slightly different in colour and in consistency. It rested on the Lias limestone, the so-called white Lias. Above the bones was the same clay, with marks of stratification visible in places, though obscure, and above it a brown stratified clay with pebbles, graduating upwards into the vegetable soil. A similar section may doubtless be seen at the edges of the present workings.

'The clay was manifestly undisturbed. No digging had taken place, for there was no mixture of the brown clay with the redder and greasier clay below. The men also were perfectly clear that it was undisturbed soil from its appearance. I suggested that perhaps a horse had been buried there; but they scouted it as impossible from the arrangement of the clay, as indeed I saw plainly was the case. Their opinion was unanimous that it was some creature swimming away from the deluge, and that the deluge had overtaken him and covered him with stones and earth. They probably also in this way accounted for the dispersed state of his bones.

'The clay contained small grains of chalk, and a few striated chalk pebbles; a pebble or two of flint, and some of lias; and was in all respects identifiable with what I have before described as the "glacial clay with chalk pebbles," to which many local patches of drift belong, and which appears to be of middle glacial age.

'It further contained remains of the shells of molluscs, too much broken for me to identify them with certainty, though I think they were the common mussel: only it seemed a smaller shell than our present

river mussel. Nothing like a whole shell could be found. Further search for shells here is most important. Some of my specimens I sent to Mr. Etheridge, of the Jermyn St. Museum, for identification.

'The bones were in a very fragmentary state; few pieces more than six inches long; and some of the largest were so soft that by no care could they be extracted from the matrix. And further, I am not sure that any of them were found in articulation with one another. No part of the bones of the head, that I could identify, were found. All that I could be certain of was that there were fragments of the horns of deer, and doubtless it will be possible from the teeth and these fragments of horn to identify the species.

'I sent early in May a hamper full of the best specimens of bones, and some of shells, to Professor Boyd Dawkins, of Owen's College, Manchester, who is one of the chief living authorities on Pleistocene Mammalia, he having kindly undertaken, at my request, to examine and report on them for the Society. His report is annexed.

'The great interest of this discovery lies in the fact that it is the first discovery of shells, and the first discovery of bones in the glacial drift in our neighbourhood. As such it is probable that it will attract some attention on the part of Geologists. I hope that in my absence some members of the Geological Section will keep a good watch on the excavations still going on in this pit.

'*Aix-les-Bains, Savoy. June* 14, 1875.

'The Owens College, Manchester,
'May 25, 1875.

'MY DEAR SIR,

'I have examined to-day the interesting collection of bones which you have sent to Owens College, and I find that they belong to the Bison and Reindeer. It is obvious that they have been derived from a fluviatile deposit, and that they have been accumulated under similar conditions to those which we find to occur in the deposit at Windy Knoll, near Castleton, described in the last number of the Quarterly Geological Journal.

'I regret that my preparation for going to the Antipodes during the long vacation prevents my giving you a longer account.

'With thanks for the Magazine,

'I am, my DEAR SIR, yours truly,
'W. BOYD DAWKINS.

'To J. M. WILSON, Rugby.

'P.S.—In the above paper you will find all the conditions accurately described.'

**On a Salamandriform Labyrinthodon (Keratespeton ? sp.) from the Coal-measures near Castlecorner, Ireland, by Dr. Oldham.*

'The specimen of a Salamandroid fossil, of which a drawing (full size) is given, belongs to the collection of the Rugby School Natural History Society. It was presented to Mr. J. M. Wilson, by a former pupil of his, Mr. J. R. Allen, and is from the Coal-measures of the Leinster

* NOTE. A hasty sketch was made of this fossil for our last Report, for 1874, (Plate 1), by C. Kerr (M). Since then, a careful sketch has been made of it by Dr. Oldham, which was accurately copied by C. Kerr, whose drawing is reproduced on Plate 7 in this Report.

Coal district in Ireland, near Castlecorner. It is from the same beds at the Jarrow Colliery, which have yielded so many other beautiful fossils of similar type, many of which have been already described by Professor Huxley.

'Unfortunately, this specimen is only a cast or mould, no part of the original bony structure being preserved, and the form being only shewn by the impression on the soft matter of the slaty coal in which it is imbedded.

'Speaking even of the most perfect of these fossils, and the mode of their preservation, Professor Huxley said, "Fossilization, however, has taken place in such a manner, that the apparently well preserved skeletons are really little but bituminous matter, replacing the proper structure of the bone, or rendering it undistinguishable from the surrounding matrix. Hence the specimens resemble casts in soft wax, which look their best at a distance, and rather lose than gain in clearness by close inspection. And those who only see the plates may be disposed to imagine that the originals are competent to afford much more information regarding anatomical details, than is to be found below." (Trans. Royal Irish Acad., vol. xxiv. p. 352.) If this be the case where the forms are retained even imperfectly, how much less of detail can be justly looked for where we have only the impression, and the impression of only one side.

'Of the specimen here figured, we have the impression of almost the entire length of the animal; possibly a joint or two of the tail is gone, but the length could not have been on the whole much greater than is represented. This gives a total length of 5.25 inches, or at the most the total length of the animal when living could not have exceeded six inches, and in all probability was less than that. Of this total length, fully, if not more than one-sixth was occupied by the head, while the body proper, up to the diminution in size marking the commencement of the tail, occupied about 2.20 to 2.25. The general form is entirely Salamandroid, while the structure would point to the Labyrinthodont nature of the animal.

'No trace of any dermal covering is observable in the impression under examination.

'It is not very clear whether the impression is that of the upper or under face of the animal. I am disposed to think it is that of the upper surface, but that this is to some extent distorted or modified by the forcible pressing down of the lower surface on the same level, so as to leave partly the impression of the lower portion overlapping the upper.

'The head was, in general form, like an isosceles or nearly equilateral triangle, with the angle at the snout truncated: the breadth of this truncation, which is at right angles to the axis of body, being about one-third of an inch or a little less. Along this line some close set teeth are observable: of these there would seem to have been three in the centre, and two rather more prominent and obliquely set at either angle of the snout.

'A little in front of the middle length of the skull, a well marked deep hole-like impression is seen, which may possibly represent the parietal foramen. In this specimen, no spaces which can with any certainty be assigned to the orbits are traceable. From the back edge of the skull two strong and slightly curved pointed horns project, the points of their insertion dividing the backward edge of the skull into three

nearly equal parts. The outer posterior angles of the skull do *not* appear in this specimen to have been prolonged into cornua, but the edge seems to have been bluntly terminated by a well raised rim, which passed round the corner and formed an ill marked boss at the very angle. The left hand side of the impression as seen in the stone seems to shew the general outline with tolerable perfection, but on the right side there is a want of symmetry, which appears to me to have been due to a slight distortion of the specimen in its entombment, so as to shove the bones of the lower jaw out of their place, and so partly to overlap those of the upper. The portion of the specimen immediately behind the skull is so poorly preserved that really nothing can be made out of it. The whole is a mass of confusion, parts of even the impression has scaled off, and it is (to me at least) unintelligible. A little behind the termination of the posterior cornua, the impression of the vertebra commences to be traceable; and, in connexion with them, ribs, very imperfectly shewn. Of these there can be counted, so far as the apparent commencement of the tail, about 20; but the number cannot be accurately determined. There is scarcely a trace of the limbs. At a little less than one half the length of the specimen (from the snout), and on the left hand side of the specimen, there is an impression of what may possibly be one of the limbs. There is some trace of what may be the bones, and also the digits of one of these limbs; but the whole is very indistinct.

'Along one side of the body, and extending the whole length of the after-portion of the animal, a slight depression seems to mark the limit of the fleshy part of the animal, as originally imbedded. Up to the point when the sudden curving in of this line of depression appears to mark the commencement of the tail of the animal, the vertebræ are very much of the same size, and of tolerably equal length also. The ribs appear to have had distinct tuberculæ; but this is not certain.

'Viewed as a whole, there would seem little doubt that this pretty little specimen represented one of the genus *Keratespeton* of Huxley, the name of which genus was based on the existence of the two remarkable posterior cornua. In general form, in apparent number of vertebræ, in their shape and proportion, this specimen agrees well with the typical one figured by Huxley *(loc. cit.)* The proportion of the head to the general length of the body, and the general form of the skull also agree entirely. In the present specimen, however, as already noticed, the posterior external angles of the skull do not appear to have been elongated into cornua as in the type specimens, but have been terminated simply by a rounded rim. Nor is it easy to see, if the suggestion that the marked hole or impression, already described, be really taken as the parietal foramen, as supposed by Huxley, for the similar and similarly placed depression or hole, in his typical specimen, why such well marked features as the orbits should not be here also traceable.

'Notwithstanding these apparent differences, however, I cannot think the state of preservation of this specimen would justify its separation from so well marked a genus. The two posterior cornua are very well seen, and though nothing trustworthy is visible of the limbs, and no trace of the pectoral arch, no sign of the dermal covering, I think we must, knowing where the specimen was obtained, admit it as a *Keratespeton*. Whether the absence of the exterior or postero-external cornua be a mark of distinction of sex, or of species, it would be rash to conclude from such evidence. And I believe it will be safer to leave this specimen without a specific name, as *Keratespeton ? sp.*, hoping that Mr. Allen may possibly find some better preserved and more distinctive specimen in his future researches.'

Botanical Section.

We have received this year notices of almost 480 flowering plants: a greater number than has been recorded for any single year previously. The number of regular observers had, during the flowering season, dwindled down to one, and in consequence a very great number of flowers were not observed at all till they had been in bloom many days; the dates of these flowers being thus all but useless for comparison. On the whole, the year has been very fairly successful.

The following new flowers have been added to the list.

Ranunculus parviflorus. Found in 1873, by Rev. A. B., on one of the mounds in the Old Lime Workings, near Little Lawford Mill. Accidentally omitted from our last Report.

Fumaria confusa. Found growing on a rubbish heap on the roadside beyond Bilton, June 21. R. D. O. [Identified by Rev. A. B.]

Viola alba. New variety. Locality, field just before arriving at Barby village from Hillmorton, April 7. H. W. T. [Must, I think, have been observed before, though not recorded.] Also, on roadside near Catthorpe, April 11. E. T. W.

Polygala (depressa). Grows on a mossy bank beside a path in Coombe Wood (Brandon end), parallel to the "twelve-o'clock-drive," May 15. H. W. T. [Identified by Rev. A. B., and formerly found in the same locality by the Birmingham Natural History Society.]

Linum angustifolia. Side of the Upper Hillmorton Road, about 1½ miles from Rugby, August 8. H. W. T.

Rosa arvatica (var. of *R. canina*). Found June, 1875, by Rev. A. B., at the woodyard, Harborough Magna.

Helosciadium inundatum. River Avon, beside the road leading from Wolston Mill towards Bretford. [Not perfectly certain as to its identity, as it was not then in flower; in other respects, it quite agrees with descriptions of *H. inundatum.*] August 5. H. W. T.

Scrophularia aquatica. A yellow variety of this was found by Rev. A. B. in a ditch close to the village of Easenhall. A yellow variety appears to be of very rare occurrence, and has only been observed two or three times before, I believe, in England.

Potamogeton rufescens. New pondweed to the list; found growing in a pond beside the bridle path leading from the Dunchurch Road in the direction of Barby, July 27. H. W. T. [Identified by Rev. A. B.]

Poa compressa. Locality, roofs of houses, walls, &c., at Harborough, by Rev. A. B.

Asplenium Trichomanes (False Maidenhair Fern). Locality, wall of tunnel over the canal near Newbold, April 1. H. W. T. [There are, I believe, only two other localities at present recorded in Warwickshire.]

New localities have been recorded as follows.

Ribes Grossularia. Lane parallel to furze-lane, leading to Rainsbrook, March 25. R. D. O. and E. T. W.

Linaria Cymbalaria. Is now growing in considerable quantities on a wall in Thurlaston, near the entrance to the village from the avenue road. Formerly recorded from Bilton; and from Church Lawford churchyard, but it has not been observed there since the restoration of the church in 1871, April 15, H. W. T.

Lamium amplexicaule. Same time and place.

Ruscus aculeatus. Growing in hedge in Bryant's lane, Hillmorton Road, in a semi-wild condition, April 29. R. D. O. Formerly found at Bilton by F. R. Smith (O.B.)

Viburnum Lantana. Hedge on both sides of road between Catthorpe and Swinford, May 8. H. W. T. Formerly at Harborough Magna.

Neottia Nidus-avis, (Bird's-nest Orchis). New locality, Coombe Wood, (Brandon end), May 15. H. W. T.

Milium effusum. New locality, Coombe Wood, (Stretton end), May 15. H. W. T.

Ophrys apifera. Railway embankment, near the "Leicester Arches," close to Rugby Wharf, June 17, by H. T. Gillson, Esq., (Hon. Mem.) Also on the canal bank near Harborough, July 17. Rev. A. B.

Digitalis purpurea. A single specimen observed growing at the edge of Lines' spinney, near Wolston Heath, June 21. R. D. O.

Aira caryophyllea. New locality, same place as last plant; also on a bank near Overslade, July 27. H. W. T. [Identified by Rev. A. B.]

Spiræa Filipendula. Canal bank, near Harborough, [formerly found some years ago by F. E. Kitchener, Esq., near Brownsover Toll Bar; not now found there], July 17. Rev. A. B.

Carduus acaulis. Two new localities. Old lime workings near Little Lawford, by Rev. A. B., and meadow beside bridle-path leading from Dunchurch Road towards Barby. H. W. T.

Linaria elatine. Cornfield beside the old canal leading from Little Lawford to Harborough, July 28. H. W. T.

Tanacetum vulgare. Is to be found in three distinct localities. (1) Railway bank of Trent Valley line, just where it crosses the Newbold footpath; (2) hedge on Upper Hillmorton Road, a little before coming to the clay pits; (3) narrow lane between Upper and Lower Hillmorton, in abundance. H. W. T.

Serratula Tinctoria. New locality, canal bank near Brinklow, August 5. H. W. T.

Ceratophyllum demersum. A single specimen on canal near Harborough. H. W. T.

Parietaria diffusa (= *officinalis*). New locality, the low wall surrounding Stanford Hall churchyard, in abundance, August 13. H. W. T.

Nepeta Cataria. Roadside between Marton station and village, on the right-hand side, facing westward, August 2. H. W. T. Formerly found at Catthorpe.

Potamogeton zosterifolius. River Avon, near Wolston Mill, growing together with *Helosciadium inundatum* [see above].

Our thanks are due to the Rev. A. Bloxam, of Harborough Magna, who has given us his valuable assistance by reporting to us new or rare plants, and by kindly identifying doubtful specimens. And here let us add that we are indebted to him for complete lists of Rosæ, Rubi, and Salices, which appear in our register of plants in this Report.

We have also a list of about 80 flowers observed in bloom on November 1st. This list, we think, must be very incomplete, and might be greatly increased if more observers gave a little assistance. The numbers refer to those in the register. They are as follows. 28, 29, 30, 51, 52, 72, 83, 86, 134, 144, 160*b*, 188, 200, 207, 210, 211, 225, 230, 264, 281, 284, 300, 314, 323, 324, 356, 362, 385, 454, 569, 585, 592, 597, 599, 606, 614, 624, 630, 639, 662, 678, 684, 688, 689, 690, 694, 712, 717, 734, 745, 748, 757, 763, 770, 818, 904, 972, 969, 992, 994, 1016, 1049, 1075, 1085, 1099, 1102, 1108, 1113, 1119, 1134, 1143, 1144, 1150, 1152, 1153, 1533, 1549, 1564, 1572.

Notices of the date-of-flowering of plants may be given to Mr. Cumming, or to the Botanical Album-keeper.

L. Cumming.
H. W. Trott.

STATISTICAL AND OTHER PAPERS.

Under this head are printed various lists and papers which it is desirable that the Society should possess in a form at once permanent and accessible.

It is believed that the subjoined letters will be of some interest to Members of the Society, as shewing that the work of the Astronomical Section is appreciated elsewhere.

The first is from S. W. Burnham, Esq., Chicago, U.S., who is confessedly the greatest living authority on the subject of double stars.

'52, VINCENNES AV., CHICAGO,
'FEBRUARY 19, 1876.

'MY DEAR SIR,

'I beg to thank you for the copy of your double star measures, received a few days since, and to congratulate you and Mr. Seabroke upon the great success you have achieved in this work. It is a most valuable contribution to astronomical science, and ought to give you a standing at once among the few good double star observers. I have gone through it very carefully, making references in my general catalogue to all the measures, and having before me nearly all prior observations of each star. I am able to form an opinion upon substantial grounds. It is the best work I am acquainted with from any English Observatory since Dawes. Another thing to be mentioned is its remarkable freedom from errors of any importance. * * * * * * *

'Wishing you much success in your observations, I remain,

'Faithfully yours,

'S. W. BURNHAM.

'MR. J. M. WILSON.'

The next is from the Rev. R. Main, Radcliffe Observer.

'RADCLIFFE OBSERVATORY, OXFORD,
'JANUARY 27, 1876.

'DEAR MR. WILSON,

'I give you my best thanks for the copy which you have sent me of the catalogue of double stars observed at the Temple Observatory, Rugby, and I congratulate you very much on your being able to produce such a series.

'The observations are not only valuable in themselves, but here is a very remarkable example of the utilization of a great public school for purposes of science, and an excellent model for those who follow in your footsteps.

'Believe me, yours very truly,

'ROBERT MAIN.'

Lastly is a note from the Bishop of Exeter.

'PLYMOUTH, JANUARY 29, 1876.

'MY DEAR WILSON,

'Thanks for the double stars. It is good to do real work at a School Observatory.

'I wish I could see a speedy hope of the building of the New Observatory. But how to get the money is not easy to see.

'Yours, F. EXON.'

A list of Land and Freshwater Shells found in the neighbourhood of Rugby, by the Rev. A. Bloxam.

In the Oxford and Coventry canal; *Dreissena polymorpha.* On timber under water, under the bridges, especially under the one near Mr. Ivens' timber yard, beyond Newbold; *Cyclas rivicola.* In the canal and river Avon; *Cyclas cornea* and *pusilla, Anodon Cygneus, Mysca pictorum* and *ovata.* In gardens and hedges; *Helix nemoralis, hortensis, aspersa.* Newbold lime pits; *Helix ericetorum, virgata, hispida.* On the banks of Clifton brook, near Brownsover Mill; *Helix nitens, lucida, crystallina, pulchella, Bulimus lubricus, Succinea amphibia, Carychium minimum, Vertigo pygmæa, Planorbis carinatus, marginatus, vortex, fontanus, contortus, albus, Limneus auricularius, pereger, stagnalis, fragilis, palustris, fossarius, Physa fortinalis, Valvata obtusa, Paludina impura, similis.* In the Bilton brook; *Ancylus fluviatilis.*

In the 9th vol. of the Magazine of Natural History for 1836, p. 572, is an account of the first discovery of *Dreissena polymorpha* as naturalized in this country, by the Rev. M. J. Berkeley, an old Rugbeian, and well known in all parts of the scientific world for his researches and publications on Fungology and other cryptogamic subjects; there is also an excellent engraving of the shell in the same. The minuter shells of the above list were found after the winter floods among the silt and rejectamenta, on the banks of the river or brook after the subsidence of the waters. At such times the conchologist may find many species, and probably several additions to the list above.

In page 46 of the Report of the Rugby School Natural History Society for the year 1870, there is a list of fossil shells in the Oxford Museum, labelled as found near Rugby. Most of these were sent by the Rev. A. Bloxam to the late Dr. Buckland, when Professor of Geology and Mineralogy to the University. They were collected chiefly in a pit, now closed, belonging to Mr. Norman of Newbold, on the west of the old canal, near Newbold. The pit was at first an open one, but afterwards a shaft was sunk, now closed up by a cone of brickwork, from which the lime was brought to the surface, but the water getting in the pit was closed. The numerous remains of extinct animals were discovered in the diluvium above the lias in the lime pits now covered with water and disused, lying to the right of the road between Little Lawford Mill and Newnham Bath, not far from the Trent Valley railway, near Finnis Field, as so marked on the Ordnance Map. (Plate 6, D.)

The Rev. A. Bloxam once accompanied Dr. Buckland to the spot, who was so fortunate as to procure some of the remains from the workmen on the spot. Numerous specimens were sent to Dr. Buckland by

the Rev. A. Bloxam, whose letters in reply are in a volume of Reliquiae Diluvianae, in the Library of Magdalen College, Oxford, given to the Library by the Rev. A. Bloxam. The specimens themselves are in the Oxford Museum, and comprise remains of the Elephant, Rhinoceros, Horse, Ox, Deer, and Hyæna.

Description of the Plates.

Plate 1 is a heliotype copy of a drawing by J. L. Tupper, Esq. (H) of a remarkable fossil. Mr. Tupper's paper on the subject will be found at page 50.

Plate 2 is a drawing by H. N. Hutchinson (C) to illustrate a paper by him on '*Shadows*,' which is printed at page 22.

Plate 3 is drawn by H. F. Newall (M) to illustrate a paper by him on '*Drops*,' printed at page 15.

Plate 4 contains figures drawn by H. F. Newall (M) to illustrate a paper by him on '*Sound*,' printed at page 33.

Plate 5 is drawn by an Anonymous Contributor, to illustrate a paper (by the same person) on '*Owls*,' printed at page 11; and it has been printed by the Papyrograph process, described at page 44.

Plate 6 is a map of two square miles in the neighbourhood of Rugby, carefully drawn by C. Kerr (M). The letters refer as follows:

- A is the spot where bones were found in drift, see page 73.
- B is the site of an ancient British settlement.
- C (on the road) is the spot where a Roman cista was found.
- D marks a place where remains of extinct animals were found, see page 80.
- E is a place where other Roman remains were found.

Plate 7 is a sketch by C. Kerr (M), of a drawing by Dr. Oldham of the Labyrinthodon fossil, described page 74.

Plate 8 is drawn by H. F. Wilson (M) to illustrate a paper by W. Larden (C) on '*Shadows*,' see page 1.

Plate 9 is drawn by H. F. Wilson (M) to illustrate Mr. Veley's paper on '*Inflorescence*,' which obtained the Society's prize last year: see page 4.

Plate 10 is an index-plan of the fossil heliotyped on Plate 1. The letters refer to the description in Mr. Tupper's paper printed at page 50. The plate is drawn by C. Kerr (M).

It will be observed that no fewer than 8 of these plates were drawn by Present Members of the School, or those who were so when the papers were read.

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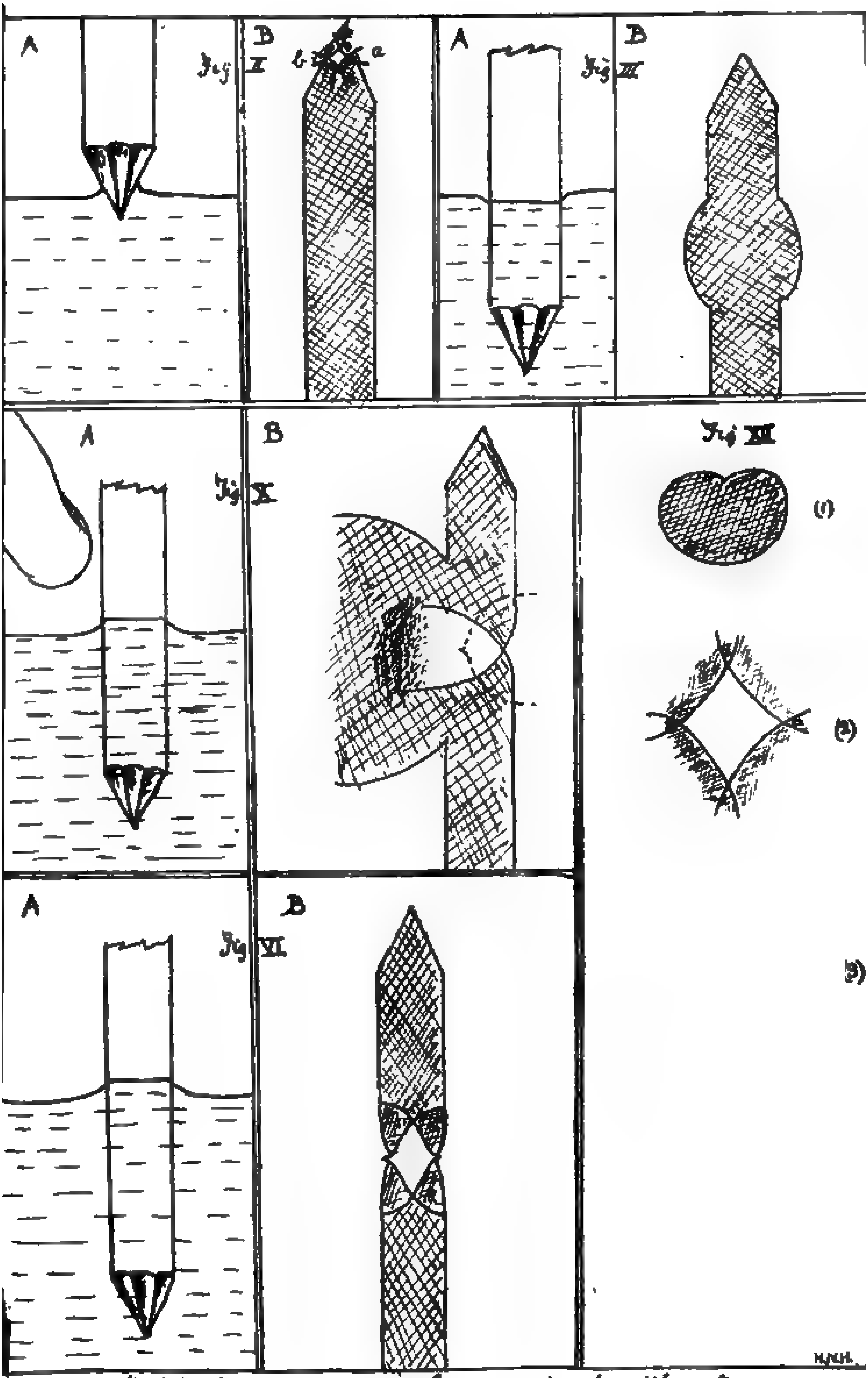
Plate L



To illustrate some optical experiments with water.

Fig. i.

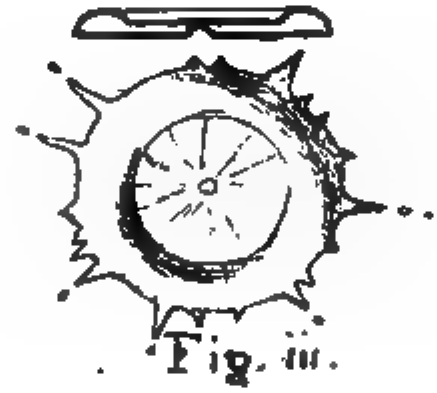


Fig. iii.

Fig. iv.

Fig. v.

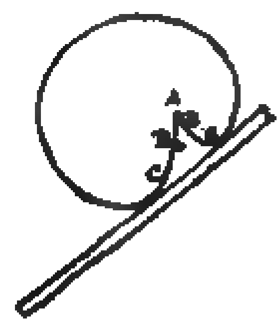


Fig. xii.

Fig. vi.

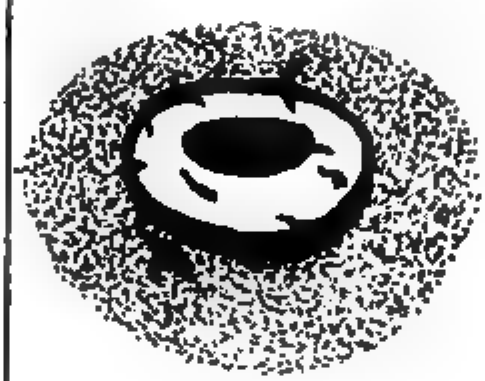
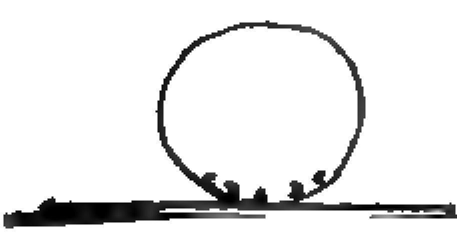
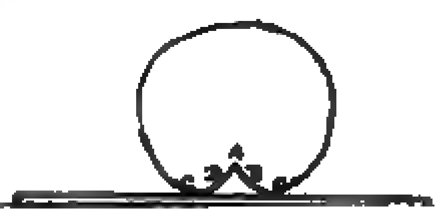


Fig. vii.

Fig. viii.





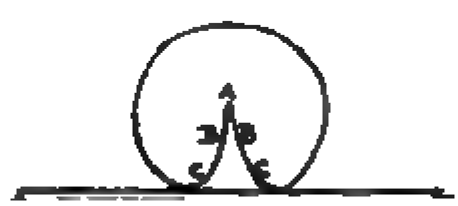
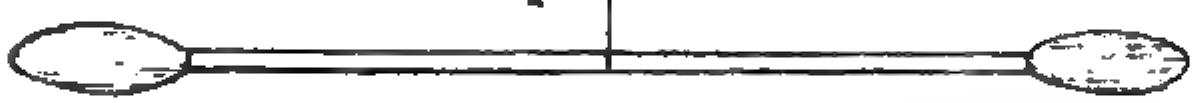


Plate 4

Fig. i



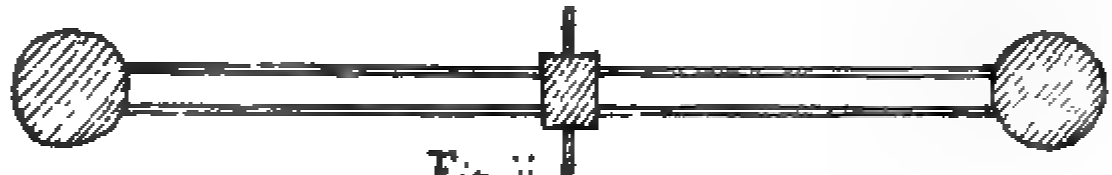


Fig. ii

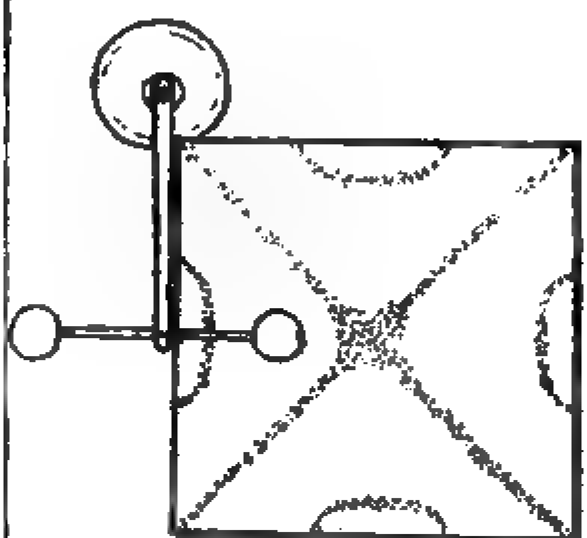


Fig. iii

Fig. iv.

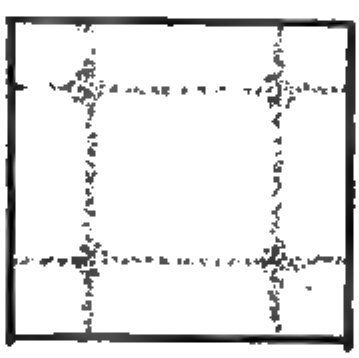


Fig. v

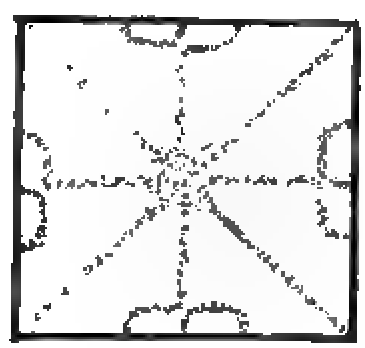


Fig. vi.

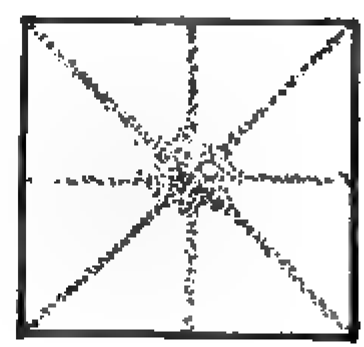
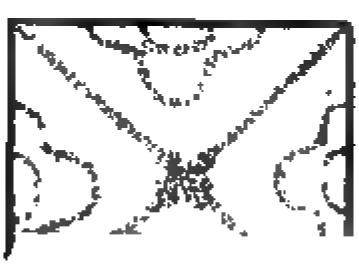
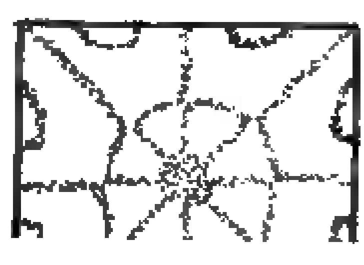
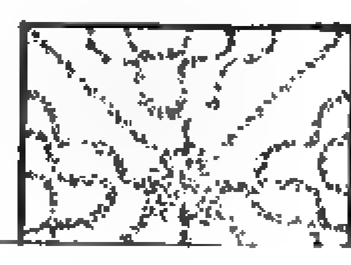


Fig. vii.







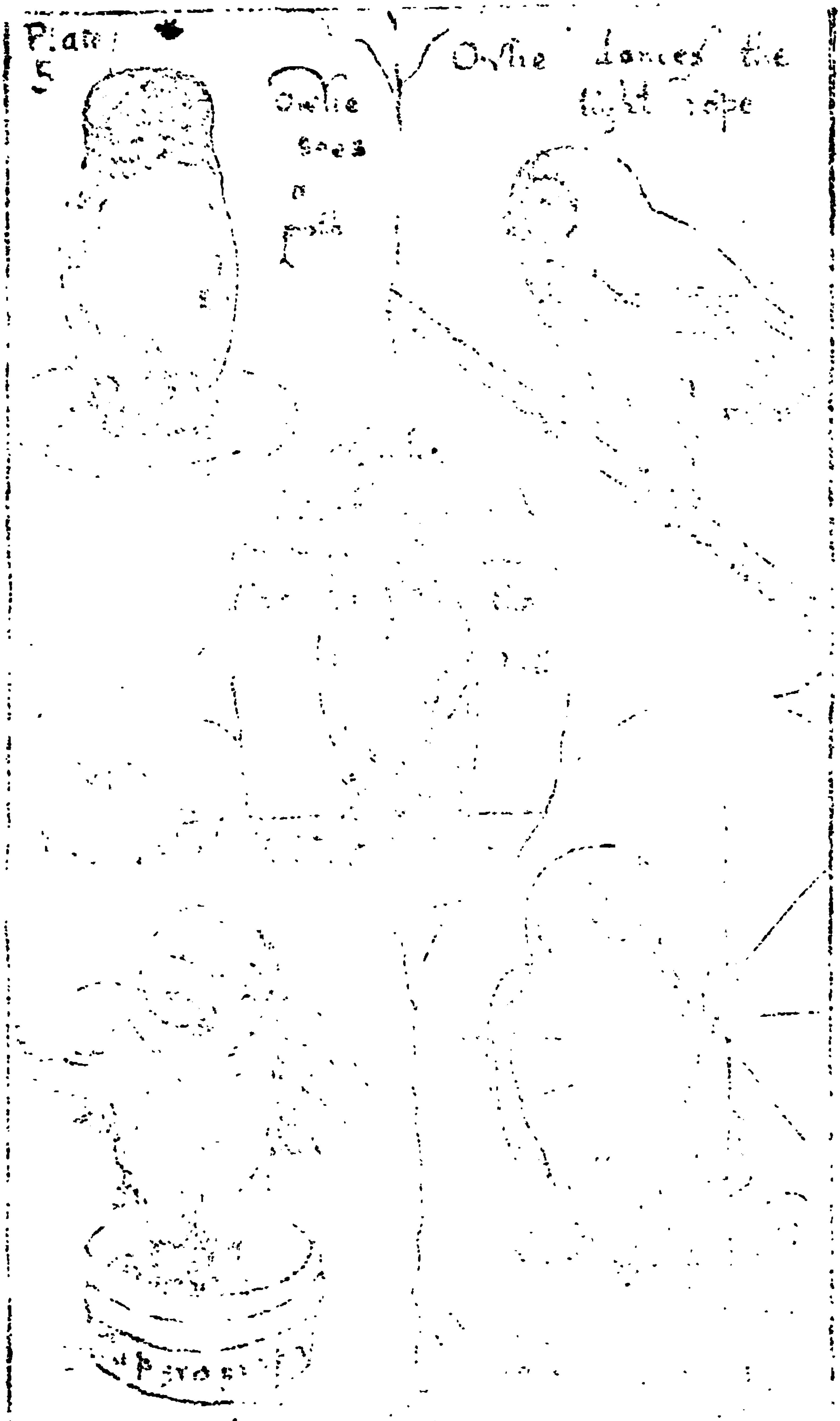


Plate 5
Ollie sees a path
Ollie dances the tight rope

Plate 8

(Fig. 1)

Shadows, before approach.

Shadows, as they appear after contact

(Fig. 2)

(Fig. 2')

Shadows, really are

as they after contact.

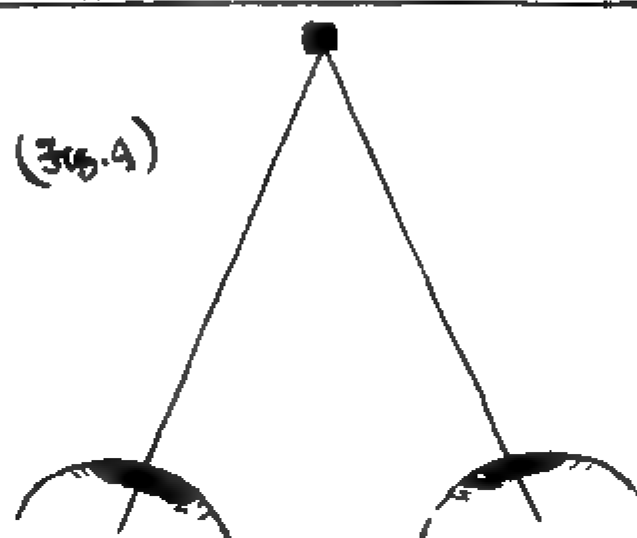
(Fig 3)

Shadows as they appear when penum have come in contact.

(Fig 3')

Shadows when penumbra have overlapped a good deal.

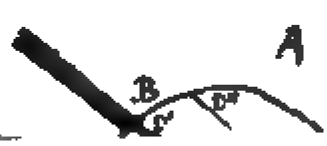
(Fig. 4)



(Fig. 6)

A. the right eye. B. the "blind spot".
C. the blot C' its image
D. the cross. D' its image.

D'', D''' images of cross when nearer or further.



(Fig 5)

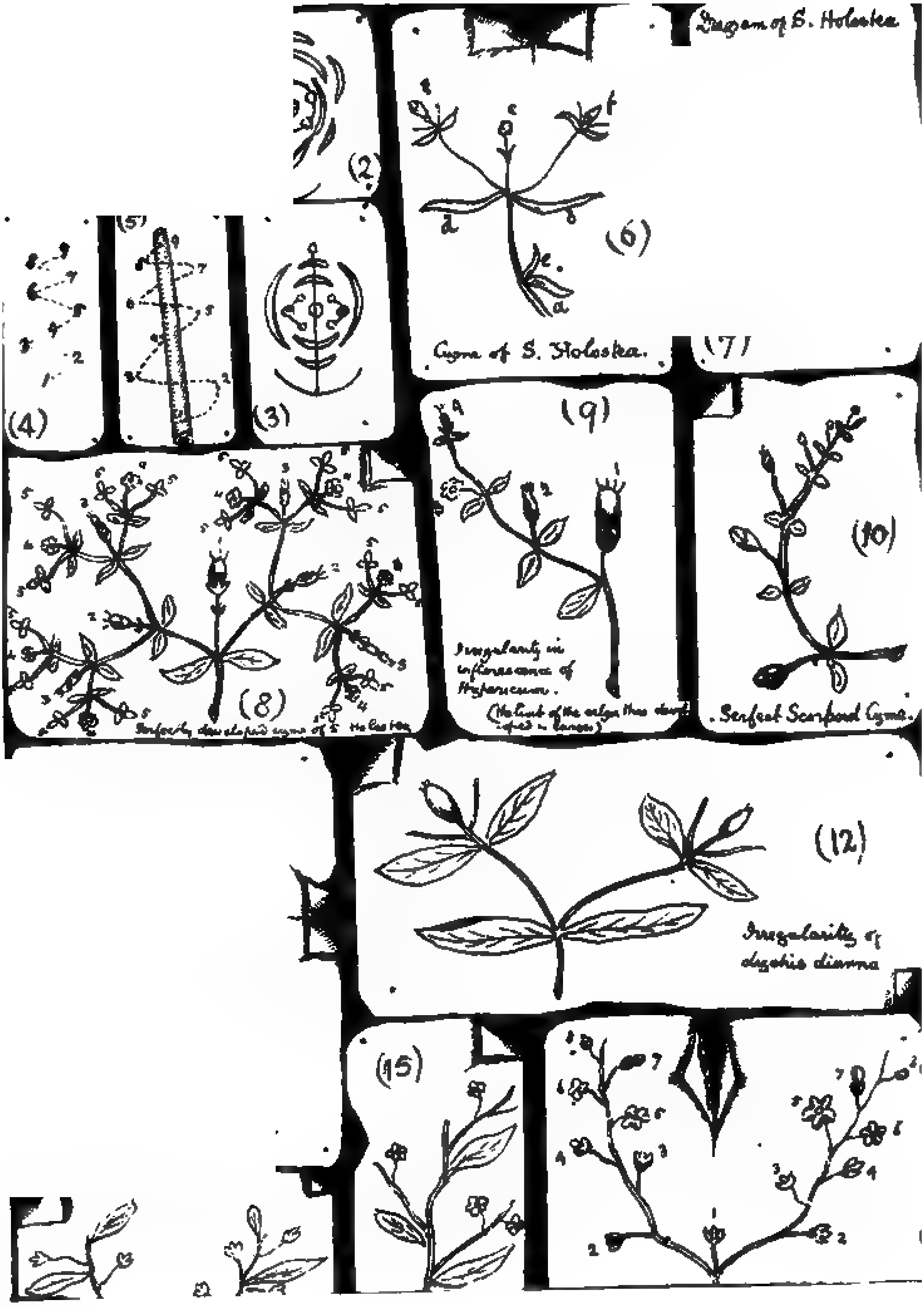


Diagram of S. Holoska
(2)
(6)
Cyme of S. Holoska.
(7)
(5)
(4)
(3)
(9)
Irregularity in inflorescence of Hypericum.
Perfect Scorpiod Cyme.
(10)
(8)
(12)
Irregularity of ... dianna
(15)

REPORT

OF

THE RUGBY SCHOOL

NATURAL HISTORY SOCIETY

FOR THE YEAR

1876.

"IIS QUIBUS NON CONJICERE ET HARIOLARI SED INVENIRE ET SCIRE PROPOSITUM EST, OMNIA A REBUS IPSIS PETENDA SUNT."

—BACON.

RUGBY: W. BILLINGTON.

1877.

PREFACE.

We are again late in our appearance, but we have a larger Report than ever, and have found it impossible to complete the publication earlier.

The Sectional work is distinctly improved since last year, on the whole.

The Botanical Section issued the long-announced list of local plants, by H. W. Trott, last October. This unpretending paper embodies the result of observations extending in some cases over eleven years, and is a most careful and valuable piece of work. We venture to call the attention of the Society to it again, as there are many copies yet unsold, and the price is ninepence. The valuable services of the author, Mr. Trott, were lost to the Society at Midsummer, but he kindly continued to hold the Album till Christmas. An active successor has been found for this year, R. C. Cordiner (M).

The Geological Section has been in abeyance during the whole year. We have at length obtained the services of T. B. Oldham (M), a brother of the last Album-keeper, whose energy we hope will revive the work of the Section.

The Entomological Section has much improved. The collections have been increased in number and wealth; the active workers have been more numerous: and the observations much fuller and more useful. There is, however, plenty more to be done, and all help is needed.

The Zoological Section has also revived since last year, but its life is not very vigorous. G. A. Solly remained with us till

Christmas, and he put the collection of eggs into better order, and added considerably to it. The observers have been few, however, the only one who gave us much help being A. C. Chapman.

The Observatory being now organised as a School Department, has passed out of our province; so that we fear we must for the future surrender even the slender claim we had to share in the credit of its valuable work.

The Meteorological Section has continued its useful labours, the record of which will be found in the usual place in our Report. But the weather-chart which appears as our Frontispiece, and which is a new feature in our Report, we owe to the great kindness, skill, and patience of the Rev. T. N. Hutchinson, to whose unfailing helpfulness our Society has been so much indebted. The same artistic hand has also drawn Plates 1, 2, 3; the two last on stone, involving much fine work, and making a most important addition to our Report.

Five of our plates are drawn by present members of the School, namely, plates 4, 6, 7, 8, 9, the last three being contributed by C. Kerr, whose sketch of the Spurs, and facsimile of the slaughter of the Dun Cow (a fabulous monster of great local celebrity), will be appreciated by all our readers.

The proportion of the papers we print which existing members of the School have contributed, shews, we venture to think, that the Society is in a fairly healthy condition: but we cannot help pointing out the small number of the active part, the members, as compared with the long list of inactive associates. Some few of the latter have helped us with observations and work: but the vast majority have contributed little or nothing. We should much like next year to be able to record an improvement in this respect.

Among many losses which the Society suffered last year, we must mention two with special and prominent regret: namely, Mr. H. W. Trott, the best Botanist we have hitherto produced, and Mr. H. F. Newall, who was not only a most efficient Secretary,

but one of the most energetic members, and by far the most original and ingenious, that we have ever possessed.

Our special thanks are due to Mr. M. H. Bloxam, who has this year become one of our most constant patrons and helpers. His inexhaustible store of curiosities, both natural and antiquarian, and his still more inexhaustible store of anecdote and information, have added greatly to the attraction and interest of our meetings.

In conclusion, we cannot help adding one word, in the name of the Society, to the tribute of respect and sorrow which all Rugby has paid to the memory of Mrs. Billington. It would clearly be out of place here to say more: but the Society owes so much to her care and generosity in the publication of their Reports, that it is impossible to say less.

A. SIDGWICK, H. F. WILSON, } *Editors.*

May, 1877.

ACCOUNTS.

May, 1876—*May*, 1877.

Cr.	£.	s.	d.		£.	s.	d. Dr.
Balance, see last Report	8	2	9	Plates	8	7	0
Subscriptions	24	17	6	Books and Periodicals	12	9	8
Sale of Reports and Keys	1	17	6	Prizes	1	15	0
Donations (J. C. and F. D. M.)	0	2	6	Cabinet and Room Expenses	3	7	0
				Breeding Cage	0	10	0
				To Mr. Seabroke, for Model	2	2	4
				Balance carried forward	6	9	3
	£35	0	3		£35	0	3

ADDRESSES.

Lithographing: F. Grew, Moor Street, Birmingham.
Anastatic Printing, and Materials: Mr. Cowell, Buttermarket, Ipswich.
Heliotype Printing: Messrs. Edwards, Lincoln Terrace, Kilburn, N.W.
Entomological Apparatus: J. Gardner, 52, High Holborn, London.
E. G. Meek, 56, Brompton Road, London, S.W.

RULES.

I.

THAT this Society be called "THE RUGBY SCHOOL NATURAL HISTORY SOCIETY."

II.

That the Society consist of Honorary Members, Corresponding Members, Members, and Associates.

III.

That Masters, and others connected with the School, or any Benefactor of the Society, be eligible as Honorary, and Old Rugbeians as Corresponding Members; that Present Rugbeians be eligible as Members, or Associates.

Of Officers:

IV.

That the Society's Officers consist of a President, Secretary, and Curator, and of the Keepers of the several Albums, and that these do form the Committee of Management, three to be a quorum.

V.

That all Officers be elected annually.

VI.

That when any office is vacant, the Committee do recommend a Member or Associate, or (for the office of President) an Honorary Member, for election by the Members of the Society, and that the election be by scrutiny.

VII.

That the President take the chair at all Meetings, but have no vote except in cases of equality.

VIII.

That the Secretary keep the Minutes of the Society's proceedings; keep a list of the existing Society, with the names and addresses, as far as possible, of all Corresponding Members, and a list of all Benefactors of the Society.

IX.

That the President and Curator form a Sub-Committee, for managing the finances and keeping the property of the Society.

X.

That the duty of the several Album Keepers be to call together Sectional Meetings; to receive all notices connected with their several Sections; to enter all occurrences of interest in their Album; and at the end of each year to furnish a Report of what has been done in their Section during the year.

XI.

That in the absence of any Officer, the Committee appoint a Deputy.

Of Honorary and Corresponding Members:

XII.

That Honorary Members be elected by open vote of the Society; pay an entrance fee of 10s. but no subscription unless specially called upon; and have all the privileges of Members, except that of voting and of receiving Report gratis: but that Benefactors of the Society who are elected Honorary Members be excused the entrance fee.

XIII.

That Corresponding Members be elected by open vote of the Society, without entrance fee, and have all the privileges of Members, except that of voting; but do not receive the Society's Reports without payment, for a supply of which they may pay a composition.

Of Members and Associates:

XIV.

That Members and Associates be proposed by a Member or Honorary Member, and elected by the Committee.

XV.

That the number of Members be limited to fifteen.

XVI.

That no one become a Member or Associate without either paying a composition of 10s., or bringing a note to the President signed by his Tutor to allow a charge of 2s. 6d. per Term to be made in his bill.

XVII.

That Members may speak at all Meetings of the Society; may read Papers with the leave of the President; may introduce four Visitors at all Public* Meetings, and receive a copy of the Society's Report.

XVIII.

That Associates have the same privileges as Members, except the right of voting at Private Business Meetings.

XIX.

That any Member who in the course of the year shall not have read a Paper before the Society, shall require re-election by the Committee.

XX.

That any Member or Associate may be suspended or expelled from the Society by a vote of two-thirds of the Members present, if he, from any misdemeanour, or want of energy, appear to deserve such suspension or expulsion: but such a motion cannot be proposed again during the same Term after it has once been voted upon in a Meeting at which four-fifths of the Members then in residence have been present.

Of Meetings:

XXI.

That Ordinary Meetings be held once a fortnight, but that the Secretary be empowered to call Extraordinary Meetings when necessary.

XXII.

That Visitors may speak and read Papers at all Public Meetings, with the leave of the President.

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* It having appeared that Members and Associates have introduced other persons not belonging to the Society into the Society's room, it is necessary to state that this practice is not permitted by the rules.

Of Reports:

XXIII.

That a Report be printed once a year, or oftener if the Committee think fit.

XXIV.

That an Editing Committee be appointed by the President for each Report.

Of New Rules:

XXV.

That, without notice given at the preceding Meeting, no change can be voted in these Rules, or any vote of Suspension or Expulsion passed.

XXVI.

That no change be made in these Rules, unless proposed by a Member or Honorary Member, and carried by the votes of two-thirds of the Members present.

XXVII.

That in all cases where one vote be wanting to make up a majority of two-thirds of the Members present, the President be allowed to vote.

PRIZES.

The Society gives a Prize (at present £2. to the first, and £1. if a second is adjudged) for an Essay on any subject connected with Natural History. The Prize is decided by a Committee of 2 Honorary and 2 Ordinary Members elected at the first meeting of the October Term. The Essays should be sent in to the President (anonymously) the second Saturday in the October Term, with a sealed envelope, containing the author's name. Preference is given to original work of any kind as compared with matter compiled from books or papers.

Former Winners of the Prize.

1871. 1. H. Ricardo, on *Eyes and No Eyes.*
2. F. R. Hodgson, on *Pets.*

1872. 1. L. Maxwell, on *Spectrum Analysis.*
2. H. N. Hutchinson, on *Motive Power.*

1873. 1. Not awarded.
2. { L. Knowles, on *Coal.*
V. H. Veley, on *Cross Fertilization.*

1874. 1. V. H. Veley, on *Symmetry in Flowers.*

1875. 1. H. F. Newall, on *Impressions.*

1876. 1. Not awarded.
2. F. G. Hitchcock, on *Dogs.*
Extra Prize. H. L. Stephen, on *Ghosts.*

LIST OF THE SOCIETY, LENT TERM, 1877.

Officers:

President: MR. A. SIDGWICK
Secretary: H. F. WILSON
Curator: L. G. LEVERSON
Curator of the Aquarium: H. STEPHEN
Librarian: M. M. ADAM
Album Keepers: Botanical, J. C. CORDINER
" " Geological, T. B. OLDHAM
" " Entomological, H. F. WILSON
" " Zoological, C. BAYLEY

Honorary Members:

REV. DR. JEX-BLAKE
REV. T. N. HUTCHINSON, F.C.S.
J. M. WILSON, ESQ., F.G.S., F.R.A.S.
REV. C. ELSEE
REV. C. E. MOBERLY
C. DUKES, ESQ., M.D.
A. PERCY SMITH, ESQ., F.C.S.
H. T. GILLSON, ESQ.
J. L. TUPPER, ESQ.
G. NUTT, ESQ.
A. E. DONKIN, ESQ.
DR. SHARP
COLONEL CARLETON
DR. MACKENZIE
L. CUMMING, ESQ.
J. COLLINS, ESQ.
M. H. BLOXAM, ESQ.
REV. C. B. HUTCHINSON
REV. C. T. ARNOLD
REV. P. BOWDEN SMITH

Corresponding Members:

LORD BISHOP OF EXETER
G. F. Helm, M.D.
E. P. Knubley
W. C. Marshall
W. C. Eyton
T. G. B. Lloyd, F.G.S.
J. R. Dakyns, H.M. Geological Survey
C. L. Rothera, B. Sc.
F. W. Fison, F.C.S.
C. S. Taylor
E. Cleminshaw
G. B. Longstaff, F.C.S.
J. S. Masterman
H. C. L. Reader
F. C. Selous
J. H. Davies
R. E. Baynes
F. R. Smith
E. W. Prevost, D. Ph., F.C.S.
J. M. Lester
H. N. Larden
H. W. Eve, F.C.S.
N. Masterman
S. Haslam
J. S. Alexander, H.M. Indian Geological Survey
B. E. Hammond
G. M. Seabroke
Rev. A. Bloxam
F. C. Bayard
Rev. J. Robertson
R. Farquharson, M.D.
G. H. Morrell
C. T. Clough
C. Hinton
E. Burchardt
A. S. Napier
R. H. Ker
A. G. Burchardt
R. H. Scott, F.R.S.
W. B. Lowe
Rev. C. J. E. Smith
F. W. Spurling
F. E. Kitchener, F.L.S.
H. N. Hutchinson
R. H. B. Bolton
H. W. Trott
M. J. Michael

[In the Report Members are marked (M), Associates (A), Honorary Members (H), and Corresponding Members (C).]
Those marked (n) have become Associates by note: see rule 16.

Members:

H. F. Wilson
C. Bayley
C. Kerr
H. L. Stephen
L. G. Leverson
T. B. Oldham
R. C. Cordiner
M. M. Adam
G. Jones
H.St.J.H.Bashall (*n*)
C. E. J. Carter

Associates:

B. R. Wise
C. A. James (*n*)
H. L. Baggallay
T. A. Wise
H. W. Fowler
W. Calvert (*n*)
A. C. Sandeman
J. C. Hurle
R. Wever (*n*)
R. A. Hughes
D. A. Hamilton
J. E. Marsh
E. Hodge
M. Firth
A. Hurrell
H. H. Cassells (*n*)
A. P. Bosanquet
J. Joicey
A. Blakiston
J. O. Fayrer
F. E. Donnison
J. R. Harvey
H. Lupton
R. J. Simey
B. B. Cubitt
F. J. Hirst
F. T. Arnold
H. V. Weisse
F. H. Edwards
R. W. Wilson
W. H. Stone
H. E. Bristow
A. Keir
J. G. Knight
R. H. Tennant
H. F. Johnson
W. H. Simpson
J. C. Cobb
A. W. Power
R. Titley
W. Willoughby (*n*)
T. H. Hadden
F. J. Hadden
A. T. Keen (*n*)
G. W. Harris
E. Bowden Smith
J. L. Teage
E. Hiron
C. H. W. King
J. C. Thornhill
G. A. Carleton
J. H. Swetenham (*n*)
J. H. Gair (*n*)
L. R. Carleton
E. D. Boggs (*n*)
A. Firth
J. H. Newton (*n*)
J. S. Campbell
F. H. Bayley
B. Z. Wright
L. A. Adamson
F. Rothera
H. C. Clifford
L. Hiley
N. F. Jenkins
S. C. Satterthwaite
H. J. Elsee
W. S. Halsey (*n*)
A. S. Maskelyne
M. E. Sadler
H. L. N. Cox (*n*)
H. S. Fraser (*n*)
A. R. Birkin (*n*)
J. K. Worthington
F. A. E. Samuelson
R. S. Benson
F. I. Maxse
G. F. S. Napier
F. D. S. Bentley Innes (*n*)
C. F. Cross (*n*)
C. D. Bradwell (*n*)
E. B. Ormond (*n*)
K. M. Cox (*n*)
W. L. Behrens
C. Smith (*n*)
H. C. Burnham (*n*)
G. W. Rhodes
E. W. Greg (*n*)
E. W. Tobin (*n*)
J. H. M. Ryan (*n*)
E. O. Bolton (*n*)
F. A. Prevost (*n*)
J. H. Wolton (*n*)
F. K. Tanner (*n*)

LIST OF PERSONS AND SOCIETIES AND JOURNALS TO WHICH COPIES OF REPORT ARE SENT.

Those marked * exchange Reports with us.

The Headmaster
The Chairman of Governing Body
The Bishop of Exeter
Lord Dormer, Grove Park, Warwick
Professor H. J. S. Smith, Oxford
Professor Newton, Cambridge
Rev. J. W. Hayward, Flintham, Notts
Rev. A. Bloxam, Harboro' Magna
Rev. A. H. Wratislaw, Bury
Rev. J. Robertson, Harrow
F. E. Kitchener, Esq., Newcastle, Staffordshire
R. H. Scott, Esq., Meteorological Office
G. J. Symons, Esq., 62, Camden Square
W. Whitaker, Esq., F.G.S., 28, Museum Street, Ipswich
S. Haslam, Esq., Uppingham
Nature, Bedford Street, Covent Garden
Geological Magazine
Jermyn Street Museum
Astronomical Society, Burlington House, W.
Linnean Society
Geological Society, Burlington House, W.
Radcliffe Observer, Oxford
Oxford Union
Cambridge Union
*King Edward's School, Birmingham
*Clifton College N.H.S.
*Marlborough " "
*Wellington " "
*Cheltenham " "
*Winchester " "
Watford "
*Warwickshire " the Museum, Warwick
Leicester Philosophical Society
*Birmingham Society
*Bristol Naturalists' Society, Museum, Queen's Road, Bristol
College, Wellington, New Zealand
U.S. Geological and Geographical Survey of Territories, Washington

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LIST OF PERIODICALS TAKEN BY THE SOCIETY,

AND KEPT IN THE SOCIETY'S ROOM.

Land and Water
The English Mechanic and World of Science
The Journal of Botany
The Entomologist
Nature
Science Gossip is kindly placed in the Society's Room by Rev. T. N. Hutchinson

LIST OF PAPERS.

Those marked * are by Members of the School.

REPORTS.

[The Geological Report which was written for the Autumn term will be given in our next year's Report.]

ERRATUM.

Page 39, line 10, *for* 'fig. 2' *read* 'fig. 4.'

MINUTES OF MEETINGS.

MEETING HELD FEB. 11. (41 present.)

Exhibition: A clay pipe from the site of Lawford Hall, apparently very old, by Mr. Caldecott.

Papers: Communication from W. C. Marshall (c), read by the President, being a selection of enquiries sent by order of the Royal Society to Sir Philiberto Vamatti, Resident in Batavia in Java Major.

'*Q.* 1. Whether diamonds and other precious stones grow again, after three or four years, in the same places where they have been digged out?

'*Q.* 3. Whether there be a hill in Sumatra which burneth continually, and a fountain which runneth pure balsam?

'*Q.* 4. What river is that in Java Major that turns wood into stone?—*A.* There is none such to our knowledge; yet I have a piece of wood with a stone at the end of it, which was told me was turned into stone by a river in Pegu; but I took it but for a foppery.

'*Q.* 6. Whether in the island of Sambrero, which lieth north of Sumatra, about eight degrees northern latitude, there be found such a vegetable as Mr. James Lancaster relates to have seen, which grows up to a tree, shrinks down, when one offers to pluck it up, into the ground, and would quite shrink if not held very hard? And whether the same, being forcibly plucked up, hath a worm for its root, diminishing more and more as the tree groweth in greatness; and as soon as the worm is wholly turned into the tree, rooting in the ground and so growing great? And whether the same plucked up young turns by that time it is dry into a hard stone, much like to white coral?

'*Q.* 10. Whether those that have been stupified by the juice of the herb datura, are recovered by moistening the soles of their feet in fair water?

'*Q.* 11. Whether a betel hath such a contrariety to the durion, that a few leaves thereof put to a whole shopful of durions will make them all rot suddenly? And whether those who have surfeited on durions, and thereby overheated themselves, do by laying one leaf of betel cold on the heart immediately cure the inflammations and recover the stomach?

'*Q.* 16. What poison is it the king of Macassar in Celebes is said to have particular to himself?

'*Q.* 29. Whether there be a tree in Mexico that yields water, wine, vinegar, oil, milk, honey, wax, thread, and needles?—*A.* The cokos tree yields all this and more.

'*Q.* 30. Whether about Java there be oysters of that vast bigness, as to weigh three hundred weight?

'*Q.* 31. Whether near Malacca there be found in the gutt of certain swine a stone esteemed incomparably above bezoar?

'From "Sprat's History of the Royal Society," in which is also to be found an article read before the Society on

'*How to Refine Salt Peter.*—After you have made your copper very clean, put in as much water as you think will dissolve the quantity of peter you propose to refine; when the water is very hot, cast in peter little by little. . . . . Some do use to throw in a shovelfull of quick lime, and say it makes "Peter the whiter and Rock the better."'

The President read the following paper, by an anonymous contributor, on '*Cats*.' [See Plate 5, drawn by the writer.]

'"Cats is dogs, and rabbits is dogs, but tortoises is insects." Such was the verdict of the porter upon the case of the old lady travelling with a few pets, confiding in the generosity of the railway company not to make her pay for the poor dumb things.

'I cannot now discuss the entire epigram, but to one passage in it I must be allowed to take very grave exception. "Cats is dogs!" Cats is not dogs, nor anything at all like them. Cats is anything else but dogs.

'Mr. Darwin enforces this truth in his "Expressions of the Emotions," by depicting the contrasting attitudes of cat and dog in approximate states of mind. The dog in anger stands erect, rigid, all in one straight line from nose to tail: the crouching cat is perhaps the most curved creature you can see. Again, Mr. Darwin's "same dog in an affectionate and humble frame" is twining his supple body up his master's leg; while pussy pleased, on the next page, rubs against it with straight limbs and perpendicular tail, the appearance of a Gothic arch in her spine, covered by crisp, happy fur, only serving to set off her general rectilinearity.

'And the difference is in more than habits. I cannot conceive that the cat's original ancestor was ever the dog's too; no, not if we go back to the times of the jelly-fish. Why is it that you may

as well invite all Bedlam to an evening party, or loose the corks of seventy soda-water bottles in your private study, as admit a strange dog to the room where sits your most philosophical cat? They are as acid and alkali to each other, as Seidlitz powders in one water; they effervesce immediately, and woe to him who would part them!

'Into my cup of life have come twenty-four common cats, and a few pure Persians. These last I must not claim to have cultivated: the one who favours us with her presence to-night was born at Clifton, and now resides in the Barby Road. Observe her tail! and above all, observe her deportment. We are indebted to the Persian or Angoran importation for the feathered tail, tufted ears, and a few habits such as playing with water, a few pretty tricks, such as opening the door and ringing the bell. A Persian, or an Egyptian, bears the mark of having been worshipped of old. It is difficult to make out exactly what cats have been worshipped, but the mummy, *F. caligulata*, has a tooth which proves, says Mr. Darwin, to a certain naturalist he knows, that it is not one among the ancestors of our cats. At the same time, our English stock has of course joined by this time with plenty of Persians. But another type, the wild cat, evidently has as much influence on our domestic breed, though it is observed by Mr. Bryce that you do no meet these savage characteristics in the south of England. In the north certainly and in the midlands you may see the low forehead, short ears, and straight thick tail—moreover, the powerful paws. I knew a fine Tom who was our neighbour's, but who used to come into our garden on summer evenings to play with our kittens, and he had these points, and short thick fur; which never might be touched, for he was the most athletic cat I ever saw. Begging little pussy's pardon, such mighty muscles and power of the side paw (the tiger's strike) could never have come of her celestial race. He would spring at the bats, and fling his gleaming white paws, from which we termed him "the beautiful boots," high up into the air, and cantering up sideways to you, would take a shot at your leg and disappear. The Cheshire cat, I aver with confidence, is of this type. A Persian cannot grin. There is one more class of characteristics which is quite discernible: I will call it the plebeian, for the heroine of the evening would be far from tolerating any one of them. Poking with the nose, carrying a remarkably pointed and thin tail sloping forwards over the back, and a rather slippery cheek, are some of them. These are the stable cats, and among these you may learn more of true felinity than among myriads of indoor pets. These are some of the most affectionate and trusting. They will put their arms round your neck, and curl about your hair; it is they who have that patient kindliness that bears the huggings of little children without one bite or scratch.

'For the Egyptian, the Persian, the Babylonian, and the Maltese, whose fur is as the weeping willow, whose tail a feathered

frosty bough, are reared in peace and plenty, and their virtues so sheltered that they do not always grow. Some do. One of the family of our late President could ring the bell, and rang it when she wanted anything. Another even now is in the habit of asking the nearest person, be he king or bishop, to open the door for her, in a way that implies that if he doesn't do it directly he is a great brute. And both were loving and intelligent. One cat in Rugby, who sits at this moment on the hearth of our present President, can open the door for herself. She is a half-Persian. With uplifted claw she hooks the edge of the door by its baize lining, pulls, and (generally) the door is open.

'Anyone likes a kitten: there is no stern dog-lover, no debilitated and nervous cat-hater, that will not smile on the airy gambols of the young of any species. Many people keep kittens, and quarrel with them for becoming cats. I never would trust human nature if I was a cat. When the early charms are over, and the first sere leaf falls upon the mature, care-worn, perfect cat, then say folk, "Cats are so (1) sleepy, (2) sordid, (3) treacherous, (4) cruel," and go on enumerating all their qualities, good and evil, as being feline and therefore bad. "Creepy" is one. I believe, from the aspect of those who use the word, that this word designates one of the cat's peculiar properties—electricity or whatever it is—that makes its touch soothing to invalids. It has soothed toothache often. But to those who do not need soothing it may be repulsive.

'Confidingness is one of the feline charms. One would expect it to thrive under the happy circumstances alone. But this is not the case. It is of the cat, not of the aristocrat. A dusty miller's mouser, kept on nothing to rid the sacks of mice, a casual street cat, who has been houseless many days, and suffered much from hunger and more from fright, will walk up to you if you wait a moment, with the most entire trust that you will save it and deliver it from loneliness and ghastly dogs. And if it didn't, who's to blame? A Frenchman named Buffon, who is called a naturalist, has written a page of abuse of cats. He says they walk away from him. He says no cat ever looked him in the face yet. No, and I should think none ever will. But I have experienced the true and loving gaze of many a pair of yellow and green eyes. And that brings me to my own cats.

'I have known twenty-four cats. We had ten at a time once, about the place, and I know a young farmer who has twenty, living in kennels. Ours were divided into the yard and kitchen cats. The out-door race were born in the straw-loft, reared on mice, and played with the horse and the pigs. The in-door were the girls', and cultivated all the year round: but sitting in the straw-loft with the kittens was the best amusement for everybody on a rainy day. The first cat-memory I have is of Totty, and how she kneaded the ground with her feet; and the next is seeing her five kittens sitting in a row in the straw-loft window, five different colours. The

yellow one carried on the line, and I can trace it on to Tommy, who sprang out of that window in the year '66, and was no more seen. Blackie and Whitie were the founders of another pedigree. They were both black and white. I should be obliged if anyone can supply me with cases of ill temper in a black and white. We were almost driven to assume a theory of temper depending some way upon colour, as deafness does. Our blacks were fast and furious, or if they got serene, they always bit us now and then. Whites I confess I knew little till I came to Rugby, and they still seem to me to be rather cold-hearted. Black and white is my chosen colour. My first kitten and my last cat were of this tint, or rather arrangement of tints, and they were angels. Yellow is friendly and hearty: can be fierce in a tom. Tabby is selfish; tortoiseshell is uncertain. These are the dogmas I gleaned from the person who of all people had reason to know cats, for she was lonely and ill most of her life, and never without cats. Dr. Stables I see assigns a certain trick, hanging on the door handle to turn it, specially to tortoise-shell. I do not press the theory, except to ask for evidence in order to dispose of or establish it.

'There was a winter when fever came to our house. There was then one cat called Megs in the house, and she kindly supplied four kittens about the time we were convalescent. I remember they were brought to me in a straw hat. Megs was an odd mixture of colours, yellow and tabby, very ugly and very sensible. She found out that one of the boy pupils was going to take a kitten home with him. On the first morning of the holidays that Easter, the cat Megs and her bairns were seen and played with at ten among the sticks, then the carriage was brought out ready for starting, and by twelve they were all gone. A rumour was abroad some days after of a cat and four kittens being "seen" by the keeper; we had game preserves close by. [It was very sad; we used to miss our pets at milk-time; then came the short, hopeless search; the sympathy from the villagers, some of whom were sure to miss their cat the same night; then the announcement of a new tail nailed up on the boards; and the mournful identification, and slow, sad transference of affection.]

'Dr. Stables' instances of longevity in cats are truly wonderful. Cats are dead and buried, literally, all in vain. A keeper found a cat in a trap, beat it about the head till blood gushed from both ears, cut off its tail and went home. The owner heard, came and took up the body and carried it home, and tried all ordinary means of resuscitation. It soon was walking about again, a Manx cat indeed, but hearty, and had the pleasure of passing by while the keeper was telling a splendid story to his friends about his combat with a wild cat, and pointing to the tail, which he had frizzed out, "Here," said he, "hangs the buffer's tail." Another cat was stoned by boys, and buried in a shallow grave. She too was dug up and recovered. Another was buried a whole day unhurt, and taken up alive. (This was meant to be a kind death: pussy thought not,

and I believe she did not remain to be buried again.) Lastly, some children saw a horrid old woman bury three kittens alive: they watched from afar for an hour, being horribly afraid of the old woman, then went and got them up, and two were still alive. I know a cat who swam in a pool of quicklime till rescued, who was nursed by an old woman who may counterpoise the last, and now hugs her round the neck so that she cannot see to wash.

'It is true that cats fish, jumping into the sea. Probably they learnt long ago not to eat grouse all the year round. It is true mothers have jumped into millponds, and rescued their deliberately drowned kittens. These things seem to be well known in the north: they are mostly Scotch cats, and so I think is the one in the legend, who was sitting washing her face (in the nursery tale), when a black cat came down the chimney and said, "Tell Dildrum Doldrum's dead." The cat replied, "Is Doldrum dead? then I must not be here," sprang up the chimney and disappeared. This myth, I have been told, is traced in all languages, like the milk-maid with her pail: but it is a little hard to see the moral of it.

'My first kitten was the most tractable I ever saw. Every day she did her lessons, every day she washed herself, and I brushed her white pinafore smooth. Then came the high jump, over my two hands. Furry looked up in my face, smiled, and went over like a bird. She could do nearly a yard. She never sneaked under at a rush, or flew at my fingers, or wasted time as naughty kittens do. She followed a cork plaything round the room on the furniture, without ever touching the floor. She worked hard at a long jump the day before she died. She was an angel in black and white fur, and I know not why she died.

'My last cat was an owl. I am not joking. Her face was circular, her eyes large and yellow, and apt to be so intently fixed on you that you turned to look at her. She had odd habits. One was "fastening herself off," a simile taken from the sewing-machine, by treading on her tail. She preferred in cold weather to have a door mat, and rising slightly on her hind legs, brought her tail round in front, like a little girl with a skipping-rope, and came down upon it. I never was more pleased than once when, having described this habit to a number of unbelieving people, we went to find the cat, and found her—in the folds of the window curtain, quite upright and owlish, and with her fore-feet on her tail. It was very odd: she took great care of her cheeks, but she neglected, nay, spited her tail. Twice she put it in the candle, and made a shocking smell, and habitually she trode on it till the tip was brown, fluffy, and quite unlike the rest of her. Another quaint custom was sitting in an extinct sparrow's nest, half-way up the vine on the house wall.* An assembly gathered, and it pleased her to have a pedestal. She had a kitten, and so had her friend, and they nursed them in one hay-nest, and each other's by turns. We

* See Plate 5, where Tiddles is represented in this attitude.

only discerned the parentage of each kit by its manners. Owlet was the undoubted son of Tiddles. He was a little saint, and died early. He used to sit on the grass on a summer night, and look up into the sky. There were sometimes bats about.

'All that I may say more is, "Never despise nor despair." Cats can become anything, or get well* of anything. Their faults are virtues upside down, and come right with care. The dogs whose moral merits are justly sung and said, have been from generation to generation the friends of man. Man has always trained, talked to, and trusted the dog, as he has frequently spoilt, secluded, and suspected the cat. Let us undo the work of generations,—love Persians, and cultivate the common cat.

'Are cats to be trusted? Yes, a cat has been trusted with the baby, and with the canary. In one case it fetched the nurse when the child fell out of bed. In the other it smote a strange cat in the face for coming near the cage. (Dr. S.) A cat's conscience is very lively, if you don't drown it with fright. A shock erases the offence from its memory, exactly as with a child. Of course, no animal who is not fed regularly is averse to helping itself. Dr. S. says cats mouse no better for being starved. They mope. In an investigation which lasted for months, he received evidence that conflicted sharply indeed: but in every case where dishonesty was proved, he found that the cat was either starved, ill-treated, or spoiled.

'Are cats more attached to places than persons? It depends on the persons. One man's cat followed him a hundred miles into Wales, finding the way by instinct. Cats are very fond of home, like Britons: they love their own haunts, and shrink from change more than dogs do. And when the family change house, the cat must be allowed plenty of time to assure her mind of what is going on; to see the old rooms are empty, to count the members of the family, and to explore every nook and corner in the new house. When you send away a kitten over one month old, expect her back by the next train, and don't flatter yourself it is *entirely* affection for you that brings her. A man—it says a young man—kicked a cat over the stair head for rubbing against him and singing her morning song. She died in three hours, bleeding all the time, but only giving a low mew, and once brightening up when he came to see her. She tried to purr to him, and died licking his hands. The doctor knew a case of a cat who lived with an old gentleman alone. When he died, she sat a fortnight in the parlour looking at his chair, and was found next morning dead on the hearth-rug. An old fiddler lived in a cottage on a moor with one cat. She followed him to the grave, and did not come home. She was heard crying for three days in the churchyard, then she scraped another grave for herself on his, and died in it.

* The Cat's Medicine Chest, price £1. 1s., with Synopsis of Diseases and their Treatment. Dean and Son, St. Dunstan's Buildings, 160A, Fleet Street.

'This is what I mean by the cat's soul. It shares with the dog a strong love for children. Nobody else may touch the giant Tom, but the youngest may seize him and pinch his two sides quite together. A little girl's cat, when she tumbles down, walks round and round her with an "Oh! oh! oh!" of sympathy such as it makes to its kittens. A loving cat knows more what to do when you are miserable than a dog. The dog is sorry, but the cat comes to you and sings you to sleep.

'Also there is an innate love of fun in a cat, that lasts long past kittenhood. A jolly little tabby or black is more joke out on a walk (a country walk) than any dog I know. My kittens used to canter sideways at snails, and go mad over their tails in the middle of the road: and then you can take them up so easily when they are tired, and they always *come clean*. However, it needs not to tell these things to lovers of fur. And the rest of the world has its principles of equality of all flesh.'

The Rev. T. N. Hutchinson then exhibited the Geissler's tubes by the aid of a Holtz machine, instead of the usual battery and Ruhmkorff's coil. This machine is very powerful, but requires that the air should be dry.

MEETING HELD FEB. 25. (39 present.)

Exhibitions: Cocoa nuts from the Irish Coast, by Mr. Cumming (H). Fossils, sent by J. E. Young (O.R.) Minerals from the Diamond Fields, sent by H. V. Ellis (O.R.) Ichthyosaurus Remains, from the Victoria Works, by Mr. Wilson. Caterpillar from New Zealand.

The President read to the Society a letter from Lord Dormer, offering to present a Collection of Coleoptera, and the Society expressed their thanks for his liberality.

Donations: The fossils and minerals above mentioned.

Papers: The Rev. T. N. Hutchinson read the Meteorological Report for the previous year. (See Report for 1875, page 62.)*

Mr. Wilson explained Peaucellier's cell, an ingenious method for converting circular into rectilinear motion.

The Rev. T. N. Hutchinson explained, with models, other methods of converting motion.

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* Copies may still be obtained from the President, price 1s. 6d.

The President then read the following paper, by H. Vicars (M), on '*Insectivorous Plants*.'

'It will be absolutely impossible, in the short space allowed me for a paper of this sort, to do anything like justice to Mr. Darwin's book, or to give any adequate idea of the immense amount of research contained in it; for it must be remembered that I have got to compress about 450 pages of print into about half-a-dozen of manuscript: therefore no one must expect me to go into details as Darwin does, or to mention half his experiments; no one must be astonished at me if I omit entirely many interesting but technical details.

'The first plant which Darwin takes is *Drosera rotundifolia*, or the common sun-dew. The leaf is almost round, and covered on the upper surface with gland-bearing filaments or tentacles (as he usually calls them): the average number of these on a leaf is about 192. The glands are each surrounded by drops of sticky secretion. The tentacles on the central part of the leaf or disc are short, and stand upright. Towards the margin they become longer, and more inclined outwards: those on the extreme margin project in the same plane with the leaf, or more commonly are considerably reflexed. A few tentacles spring from the base of the footstalk, and these are the longest of all, being sometimes nearly a quarter of an inch in length. Darwin then goes off into a long discussion about the glands, which if I were to begin upon would take up my whole paper and a lot more besides. It must be enough to know that in these glands and their stalks or pedicils there is a certain fluid which is affected by contact with various acids, hot water, raw meat, &c., in different ways. "If a small organic or inorganic object be placed on the glands in the centre of the leaf, these transmit a motor impulse to the marginal tentacles. The nearer ones are first affected, and slowly bend towards the centre; then those farther off, until at last all become closely inflected over the object." This takes place in from one hour to four or five hours. The difference in time depends upon many circumstances: the nature of the object; if it contain soluble matter of the proper kind; the age and vigour of the leaf, &c. A living insect is better than a dead one; for the former kicks about and presses the glands of more tentacles: a fly is better than a beetle, because a fly is more juicy, and hasn't got so thick a skin.

'It is possible to make the tentacles curve inwards by brushing them slightly but repeatedly, although no object is left on them: also by placing drops of a solution of any salt of ammonia on the central glands. The smallest possible bit of glass or hair placed on an outer tentacle will cause it to be inflected rapidly.

'When any strongly exciting substance or fluid is placed on the disc, sometimes even the blade of the leaf is curved inwards: drops of milk, or of solutions of nitrate of ammonia or soda, or

bits of hard-boiled egg, were all found to cause in some cases this inflection of the leaf itself.

'The length of time during which the glands remain inflected depends upon whether they find that anything worth having has been caught: if it is worth eating, that is, if they can eat it, they stop to do so. They are not very quick eaters; in fact, they will make one small fly or a little bit of raw meat last a whole week, though they are dining incessantly during that period.

'The secretion from the glands is greatly increased by merely touching them, or by immersion in solutions of various acids, &c. By touching the central tentacles the outer ones are made to bend inwards, and before they touch anything the secretion is increased visibly. A still more important fact is, that when the tentacles become thus inflected the secretion changes not only in quantity but also its nature, and becomes an acid: as long as the tentacles remain inflected, the glands secrete and the secretion is acid. This secretion seems to possess, like the gastric juice of the higher animals, some antiseptic power. He then gives in proof of this statement the following experiment:—Two equal sized bits of raw meat were placed close together, one on a leaf of a sun-dew, the other in some wet moss. They were left for 48 hours, and then examined. The bit on the moss was decayed considerably, and swarmed with infusoria, while the bit on the sun-dew, which was bathed by the secretion, was quite free from infusoria, and untouched by decay in the central and undissolved portion.

'As soon as tentacles which have been inflected over an object for several days begin to re-expand, their glands secrete less freely, or do not secrete at all, and are left dry. Then the remains of the objects upon which they had been dining could be blown away with the greatest ease, leaving the leaf unencumbered, and free for future action. When the re-expansion is complete, the glands begin again to secrete freely as before.

'Whenever an insect alights on the leaf, no matter on what part of it, it is always ultimately carried to the centre, and surrounded by the inflected tentacles. There is probably some attraction in the smell of the secretion which entices insects to alight on the leaf: once they have committed this act of indiscretion, their fate is sealed, or nearly so; for there is uncommonly little chance of escape from the embrace of those greedy tentacles, which hold their prey nearly as surely as the arms of an octopus.

'That Drosera does absorb animal matter is beyond all doubt, as proved by experiments and the action of the plant itself: and this fact explains how Drosera can flourish in extremely poor peaty soil, where often no other plant could possibly live and grow: this also explains why the roots are so poorly developed; these latter are used only, or at any rate principally, to imbibe water alone, as they must require a large supply of this to keep up the sticky secretion under a glaring hot sun all day long.

'Darwin now goes on to give an innumerable multitude of

experiments upon the glands of the tentacles, as regards their inflection. All these I must miss, and simply give the most remarkable case in which inflection was obtained: a particle of hair $\frac{8}{1000}$ of an inch in length, and weighing $\frac{1}{78740}$ of a grain, placed on the sticky secretion of a gland, caused that tentacle to bend inwards.

'To give the results of his experiments and his conclusions will be sufficient without going into detail. He decided that it *could* not be the *weight* of such a particle as that of which I have given the dimensions, which caused the tentacles to bend, for drops of water many times heavier had no such effect: finally he observed that the object, whatever it was, was always drawn down through the secretion so that one part of it touched the gland itself: it was this slight pressure or irritation which caused the tentacle to move, so he concluded. It is hard to imagine a bit of hair $\frac{8}{1000}$ of an inch long, supported, too, in a dense secretion, having sufficient weight to cause strong and marked movement in the tentacle: and yet such is what Darwin tells us did happen and does happen. It is extremely doubtful, as he says, whether any nerve in the human body, even if in an inflamed condition, would be in any way affected by such a particle supported in a dense fluid, and slowly brought into contact with the nerve.

'Repeated touches, we have said, caused the tentacles to bend; but a single touch, or even two or three touches, with sufficient force to bend the tentacles touched, have no effect whatever. This fact must be of service to the plant, as occasional touches from such objects as blades of grass or dead leaves blown about by the wind must occur, and it would be worse than useless for the plant to waste its strength on imaginary nothings. It must be remarked that drops of rain, however heavy, even though they wash off the secretion entirely, have no power whatever of inflecting the tentacles.

'Of the process of "aggregation," I will say merely this. To the uninitiated this word will probably be devoid of meaning, so I will try very briefly to explain it. The cells in a tentacle of a young but mature plant that has never been inflected, contain a purple homogeneous fluid: when this fluid becomes filled with granular masses of a purple colour, and is itself no longer purple, but colourless, the process of aggregation is said to have taken place. Many things produce aggregation, viz., immersion in various compounds, by heat, by the glands being touched repeatedly, &c.: the most remarkably slight cause which produces it, is the absorption of $\frac{1}{134400}$ of a grain of carbonate of ammonia: this is sufficient to cause aggregation in all the cells of the same tentacle.

'Next follow Darwin's experiments as to the effect of heat upon these plants. He starts by boiling one. It is scarcely wonderful that the poor thing did not survive. He then tries lower temperatures, 80°F.—110°F.: as the result he finds that a warm bath increases their appetite, that is, if we may judge by the vigour of

their movements. A temperature of from 120°F.—125° excites the tentacles, but does not kill them. At 130°F. the leaf evidently finds the water too hot; so much so, that for the time it is partially paralysed. At 145°F. some leaves expired; some however survived, but their constitutions seemed quite destroyed. At 150°F. the leaves turned black and blue, and at once gave up the ghost.

'The only remarkable thing here is the amount of heat one of these leaves can stand without being absolutely killed straight off, as one would expect.

'Without going into the subject next treated (viz., the effects of organic fluids), I will give his conclusions. Non-nitrogenous fluids have no effect whatever upon the leaves: nitrogenous fluids cause marked inflection.

'Darwin now goes at great length into the question of the digestive power of the sun-dew: this I am compelled to cut very short, and thereby to omit much interesting detail. If anyone really cares to know anything about this subject, he had better beg, borrow, or steal the book, and read it up for himself; for I do not, and cannot pretend to give more than a bare outline of the subject. When the glands are excited by nitrogenous matter, they secrete more copiously, and this secretion now given out has the power of dissolving, that is digesting, many organic substances; such as albumen, muscle, gelatin, the fibrous parts of bone, raw meat, decoction of cabbages. If you give a leaf too much to eat, he dies, apparently of surfeit, just as an animal would if fed beyond the limits of his expansion. It is very curious and interesting to notice how exactly the acid secretion of this plant corresponds to the gastric juice of the higher animals.

'It would be found very wearisome were I to give in full all the particulars of the next series of experiments. He administers doses of various salts of ammonia to multitudes of leaves, and gives the results in detail. The most astonishing thing among these is, I think, the smallness of the doses which cause inflection in the tentacles: $\frac{1}{691200}$ of a grain of nitrate of ammonia, or $\frac{1}{19760000}$ of a grain of phosphate of ammonia, is sufficient to cause a tentacle which has absorbed that amount to be inflected!

'Next follows a long list of experiments with various salts, some of which did not injure the plants, some had no effect, and some killed the plants with various degrees of rapidity: I will just give three examples. Sodium carbonate causes inflection, but is not poisonous; potassium phosphate has no effect; silver nitrate causes rapid inflection and death. Then he tries acids, the majority of which are poisonous to the plants, and most of them excite inflection of the tentacles. It seems, however, by no means a rule, that what is poisonous to animals will be poisonous to Drosera, or *vice versâ*. For instance, the poison of the cobra, though so deadly to animals, is not at all poisonous to this plant. Drosera is evidently of very temperate habits, and might be taken

as the emblem of teetotalism: for it steadfastly refuses to imbibe alcohol even when dilute, and consequently is in no way affected by it; but it is not able to withstand the influence of the vapour of alcohol, and dies if exposed long to its action. An earnest teetotaller could preach for a week on the noble example set by this lowly plant!

'At last we have done with Drosera. We now come to a plant commonly called Venus' fly-trap, or scientifically *Dionæa muscipula*. The leaf consists of two lobes, which stand on the midrib at rather less than a right angle to one another. Three minute filaments project from the upper surfaces of both. These filaments are extremely sensitive to touch, as shown not by their own movement, but by that of the lobes. The margins of the leaf are prolonged into spikes, which stand in such a position that when the lobes close on a captured insect, they interlock like the teeth of a rat-trap. All over the upper surface of the lobes are small glands, which secrete when the leaf closes over a fly. This secretion has the power of digesting, like that of Drosera. The most striking difference between this plant and the one which we have just disposed of is, that whereas Drosera catches its prey on the bird lime principle, and is very slow in its movements (for it has no reason to hurry itself), Dionœa having no sticky secretion to entangle its prey, closes rapidly, on the rat-trap and mouse-trap principle, trusting and depending solely on its quickness. To aid the accomplishment of this, the sensitive filaments are made more sensitive to a single, rapid touch, than to prolonged but gradual pressure. Darwin explains the object of the marginal spikes thus. When the lobes begin to close, each lobe itself curves inwards, and the marginal spikes interlock partially and gradually: at first their tips, and by degrees at last their bases. Now, until the margins of the lobes themselves close, there is room between the spikes for small insects to escape, as in all probability they would try to when they saw the increasing darkness, and were disturbed by the closing lobes. That very small insects should escape would be manifestly advantageous to the plant, as by closing over very small objects which don't contain much nourishment, a great deal of strength is wasted, and the leaf injured.

'This interesting plant only grows in North Carolina, so that except in imported specimens kept in conservatories, there is little chance of seeing it in life and action.

'Then follows a description of, with experiments upon, several more plants, some of which close like a trap upon their prey, some depend solely upon their sticky secretion; and all of which have the power of digesting animal matter. With this slight notice I pass over these.

'An interesting plant is now examined and described. To give a very general idea of what it is like—It consists of a rootless mass of slender branches on which grow small bladders: each of these is fitted with a valve or trap-door opening inwards easily, but

unopenable from inside. The plant is aquatic, and floats near the surface of the water. The bladders are filled with water more or less pure. The process by which the prey is captured is simple in the extreme: some small aquatic insect, either from curiosity or some other motive best known to it, pushes its head against the trap-door, which yields to the slightest pressure. Having got so far, sometimes it will take fright and endeavour to retreat; but this may not be—the door is pressing upon it and holding it fast from going back, though it offers next to no resistance to entering. The wretched insect kicks, and struggles, and wriggles in its attempts to get free, the only result being that it wriggles itself further than ever into the fatal trap. Once safely inside, the insect swims about till it dies, and there seems no reason to suppose that death is hastened by any secretion given out by the plant. After death, not unnaturally, the creature decays, and the decayed matter is absorbed by the glands on the inside of the bladder. But it must be understood clearly that this plant *does not digest* animal matter like Drosera or Dionœa, but simply *absorbs* decayed animal matter. By experiments Darwin found that the glands had the power of absorbing weak solutions of certain salts of ammonia and putrid infusion of raw meat.

'Several other plants of the same kind as this are next described, but it will be impossible for me to say anything about them here, interesting though they are. Lastly, he gives a plant constructed on the principle of an eel-trap. There are long narrow tubes with layers of hairs pointing inwards: so that once an insect has been foolish enough to enter, it will in all probability never be able to get out again. There are glands within the trap which absorb decayed matter, but there is no digestive power.

'It must be clearly evident, even from the slight sketch which I have given, that these plants *do* obtain nourishment from the (i.) digestion and (ii.) absorption of animal matter; and some, also, from matter which they can dissolve out of vegetable substances: and that they are almost solely dependent upon this sort of nourishment and food is made plain by the smallness and sometimes even absence of their roots.

'I have done: but, as I said before, in justice to Mr. Darwin, don't judge his book by my paper, but get it and read it for yourselves,—that is, of course, those who feel any interest in the subject,—and when you have read it, don't be too hard on me and my delinquencies.'

H. F. Newall (M) then called attention to the cannibalism of these plants, which he had observed during the Midsummer holidays.

MEETING HELD MARCH 11. (— present.)

Exhibitions: Sediment from a kitchen boiler. Head and other parts of an Ichthyosaurus (eye 13 in. by 7 in., jaw 6 ft. long), by Mr. Wilson. Glaciated Stones from Leicestershire, by G. M. Seabroke (c).

Mr. Wilson, who, in the absence of the President, was in the chair, announced that Mr. Robertson, of Harrow, had presented £10. to the Society. The best thanks of the Society were conveyed to Mr. Robertson for his generosity.

Papers: M. J. Michael (M) sent the following note on the '*New Zealand Caterpillar*' exhibited last time.

'At the last meeting of the Society, Mr. Wilson was kind enough to exhibit some curious caterpillars, of the kind which the *Cornhill Magazine* of January said "turned into 'trees'": that is, a shoot grew out of their head, upon their burrowing into the earth; which they did presumably to resume the pupa state.

'Since no one was able positively to assign the cause for this strange metamorphosis, I respectfully lay the following facts before the Society. First, I ought to mention that Mr. Cumming, in giving a probable solution of this seeming mystery, stated what is really the fact, namely, that while living on the tree, this, the caterpillar of the New Zealand Swift Moth (*Hepialus Virescens*), is attacked by a fungus (*Sphaeria cordiceps Robertsi*), which destroys it (as we saw from the specimens exhibited at the last meeting), the fructifications being placed at the end of a long stalk which grows out of the head of its "*Host.*"

'This *Sphaeria* completely destroys all trace of the organization of the caterpillar, at least such I found to be the case on examining one under the microscope: the contents of the body were uniformly the same, and identical with the contents of the shoot, the whole being like a sack in the form of a caterpillar, stuffed with crystallized sugar.

'The outward appearance is most accurately preserved, so much so that the lateral holes in the body through which, when alive, the caterpillar breathes, were perfectly visible in the "*wooden*" specimen.

'Nor is this the only example in nature of this kind, for the caterpillar of some of the silkworm species is attacked by a very similar fungoid growth.

'Again, another of the *Sphaeria* is parasitic, namely, *Sphaeria Simervis*, which, after it has reduced the caterpillar to the "*wooden*" state, is used by the Chinese as a drug.

'Hoping these facts may prove of interest to the members of the Society interested in this subject.'

H. F. Newall (M) read the following paper on the '*Radiometer.*'

'Some years ago, Mr. Crookes discovered that the rays of light and heat possessed motive power, and the perfection of the forms of instrument for demonstrating this fact is the Radiometer.

'In making experiments with this marvellous little instrument, one always has the satisfaction of feeling that, though one most probably will not find out the reason of the rotation, still one may help towards finding it, by some little experiment which it may not have occurred to others to try. With such thoughts I purchased a Radiometer.

'Some might think that I should be prejudiced against theories already given by scientific men, and so should be unwilling to notice some things, whilst I should be extremely likely to exaggerate others. However, I have done my best to show to you in as true a manner as possible the results of my experiments.

'My thoughts as to the cause of the rotation of the wheel were as follows:—As there are two apparently totally different forms of the same thing in the case of carbon, namely the diamond and charcoal, so I imagined there must be two different forms of a something, which under different circumstances would appear as *light* and *heat*. That "something" must be a form of vibration, which in a certain combination would tend to form *light*, and, in another combination, *heat*. And so my object was to compare, or rather contrast, as much as possible, the different effects of light and heat, and from the results of my experiments conjecture as to what that mysterious something is. The general results have been to show that light has little or nothing to do with the rotation, and so I have generally discussed in my paper Professor Osborne Reynolds' theory, which I shall presently mention, sometimes adducing facts for it, sometimes against it.

'Therefore, as this vibration seems to have much more intensity, or, let us say, power of transmitting motion, when in the combination which forms heat, let us first take together as much as possible the experiments with heat alone.

'I placed the Radiometer near the fire, that is, about two feet from it, and it spun round at so great a rate that the wheel was invisible.

'I placed the Radiometer on a table in a dark room. Having heated a poker to a very dull red heat, and then allowed it to cool so far that there was no light whatever visible to the eye, I then approached it to the Radiometer, and held it there for a few moments. Then taking an unlighted match, I gradually passed it down the poker till the heat was sufficient to ignite the match. The Radiometer was found to be going round at a brisk pace, evidently moved by black heat alone, as it was impossible to suppose correctly that the rotation was caused by the ignition, and consequently the light of the match.

'The following experiment, though not really connected with

heat alone, gave rise to one which was so connected. I lighted a match in a dark room, and suddenly approached it to within one inch, and then withdrew it to about four feet distance from the Radiometer. The wheel did not begin the moment I approached the match, but when I had withdrawn it for a second or two, then the wheel began, and rotated tolerably briskly. This explanation suggests itself—that it is not the light that causes the rotation, but heat; for the glass could, I imagine, for a certain time hinder the heat, but *not the light*, from passing to the discs, and so prevent the wheel from rotating immediately. But someone may say that in the ordinary state of things, one could not expect the wheel to get up its rate, immediately a force was exerted on it. But I do not say this. I say the wheel does not *begin* the moment the source from which the force comes is brought near it.

'The following explanation, I believe, was given by Professor Osborne Reynolds. The residual gaseous fumes in the vacuum collect upon the black surfaces of the discs, and so when heat is applied, these fumes are driven off, or rather drive off the discs. Consequently we are to suppose that the black on the mica discs allows the fumes to condense in larger quantities on the black than on the white side: and that so more fumes come from the black, and thus the wheel is driven round, with the black discs repelled.

'It is impossible to get a perfect vacuum. It is said that if mercury be used as a means of making the vacuum—as is the case in this instrument, I believe—mercury fumes must exist in that vacuous space, however long the exhaustion be continued. But why is this so? If the mercury fumes when they come off into the vacuum immediately condense, why should they come off at all? or if they come off, why should they immediately condense again?

'Professor Osborne Reynolds' explanation immediately suggests another experiment. For one thinks of it thus. If we continue the heating long enough, surely the fumes will all be driven off, and so the motive power will be exhausted. With the wish to see if such would be the case, I placed the Radiometer about 1½ feet from the fire, and left it there for 35 minutes, and still the wheel seemed to be going round as fast as ever.*

'Again, I placed the Radiometer inside two glass shades inverted, having previously filled the space between the two shades with hot water, at about 120° Fahrenheit. The wheel immediately commenced to go. In a short time, however, its speed diminished, and at last it stopped altogether. Now by Professor Osborne Reynolds' explanation, we must suppose that when the wheel stops all the fumes have come off which can come off. But now make the water hotter, and the wheel begins again.

'Then when we discontinue the heating, what would happen?

* I have tried this experiment again, and with different results. The rate of motion of the wheel sensibly diminished.

The fumes would be condensed again upon the surfaces of the discs, principally on the black surfaces. What effect would this have upon the wheel? One may suppose two things, I think—(i.) that for a time the settling of the fumes would keep the wheel rotating; for they would strike the discs, so to speak, in settling on them: (ii.) that as the evaporation caused by heat repelled the discs, so the condensation caused by cold would attract them.

'The following experiment points to the latter case. I heated the Radiometer for half a minute, at about 1½ feet from the fire, where the wheel was going so quickly as to be invisible. Then removing it from there, I placed it on the window sill in the diffused daylight, and blew upon it, thus making it cold. The wheel quickly stopped, and then went round the other way: that is, repelling the white. Thus cold has the opposite effect of heat.

'Again, after the Radiometer was taken out of the shades containing hot water, just mentioned, and placed in the room, the white discs were repelled even in the light of two or three candles. The wheel made several revolutions in this direction.

'From these experiments we may assume that any object will make the wheel go round, as long as the temperature of the object is very sensibly greater or less than that of the wheel: but that the moment the wheel is heated to the temperature of the object, or at any rate when the temperatures of the two are not very sensibly different, then the motion ceases.

'Again, to centralize the heat, or in other words to get it on to one spot on the outer coating of the Radiometer, I put a drop of hot water on to the top, and let it run down, thus forming a line of heat: and I noticed that when the white was nearer than the black disc, it was repelled as briskly as the black when it was the nearer. But when the repulsion of the white disc brought the black one near on the other side, then it in turn was repelled, and so again the white one.

'This fact makes it evident that it is simply that the heat can act *more* upon the black than on the white disc, that makes the wheel go round in a certain direction, and not that the heat acts *only* on the black and does not affect the white disc.

'Again, to try the effect of centralizing cold, I placed a drop of chloroform on the bulb, and let it run down, intending to make use of the rapid evaporation of the liquid as a means of producing cold: and as was to be expected, the disc which was nearer the line of cold was attracted. And in this case the disc was carried slightly beyond the line of cold by the impetus it had gained in the attraction, and then it was attracted from the other side: and so the disc oscillated backwards and forwards, till it came to rest opposite the line of cold. But the black was apparently attracted no more than the white disc, again showing that it is simply a matter of the difference, in the power to absorb heat, of the black and white discs.

'I tried the effect of casting a ray of heat and light from a

candle through a small hole on to the white disc only. The wheel was motionless. I left the ray still directed on to the same disc for about ten minutes. Still the wheel was motionless. This absence of motion one may perhaps explain as follows. The action of the ray is to repel the disc, by evaporating the fumes collected on the white side. But whilst we heat the white side, we heat the whole disc, and so drive off fumes from the black side also, fumes which tend to drive the wheel in the opposite direction to that in which the ray of heat and light wishes to send it.

'The next experiment I tried was this. I placed the Radiometer in the inverted shades, using hot water between them. The wheel revolved for some time, and then stopped. Then I took a candle, and placed it eight inches from the wheel. No movement was visible. I placed a lens between the candle and the wheel, casting an inverted image of the candle on to the black disc, and the wheel revolved.

'The water was at 129° Fahr. when I began to take the time of a revolution, and after I had taken it five times, it had fallen to 123°.

'Average time for 1 revolution, taken from 5 trials, 23¼ seconds. The first of the 5 trials was 24, the second and third slower very slightly, and the last two distinctly less, the last being 21½ seconds.

'I have not had time to make further experiments with the difference of temperature in the water.

'Next I used cold water instead of hot, and placed the candle and lens in the same position.

'The water was at 57° Fahr. both at starting and ending the trials.

'Slowest time for 1 revolution		...	12¾ seconds.
'Quickest	,,	,,	...	9¾ ,,
'Average	,,	,,	...	11½ ,,

'Taken from 5 trials.

'I cannot account for the difference in the times in the latter case, as the circumstances were in every case the same. I have met with the same differences in timing revolutions with coloured glass; of this I shall speak presently.

'The question now arises from the experiment of the hot water and the additional heat of the candle, why should heat which proceeds equally from every point in the circle round the Radiometer stop the rotation in a short time, whilst heat from one point, as for instance from one candle, makes it rotate continuously. I have not had time to make the experiment of placing the Radiometer in a circle of lighted candles. I shall do so, however, shortly; and shall perhaps ask your indulgence for a second paper, containing an account of this and other experiments.

'The next experiment was this: I placed a candle 8½ inches off the Radiometer, with the centre of the flame on a level with the wheel. One rotation I timed 5 times, and got it to be, on an average, 5 seconds.

'Then I put the same candle at the same distance, but 6½ inches below the level. One rotation I timed 5 times.

'Average time for 1 rotation, 6¼ seconds.

'Again, I placed the same candle at the same distance, but 6½ inches above the level. I timed 1 rotation 5 times.

'Average time for 1 rotation, 7¾ seconds.

'This experiment, I think, shows how much more heat has to do with the rotation than light: for the light surely would be the same, whether the candle was 6 inches above or 6 inches below the level. But would the heat also be the same? No. When the candle is below, a column of heated air passes upwards, and so heat passes from this column, horizontally, to the wheel: and thus the candle is not the only source of heat. But when the candle is above the level of the wheel, the heated column ascends, but it does not pass the Radiometer in its upward course, and so no heat passes from the column to the discs: therefore the heat is greater, as far as the Radiometer is concerned, when the candle is below. And, as is to be expected, the wheel goes round quicker.

'Time for 1 rotation when candle is above, 7¾ seconds.

'Time for 1 rotation when candle is below, 6¼ seconds.

'The reason why the wheel goes faster when the candle is on the same level, evidently is that the rays have more power from being vertical to the surface of the discs.

'Now, after experiments with heat and its negative, cold, let us pass on to experiments with light and its negative, darkness.

'Ridiculous as it may seem to make any reference to the negative of light as having any power, yet I think one ought not to overlook it. And still I am sure you will be amused when I tell you that I did actually try if darkness after intense light had the contrary effect of light. It is natural to suppose that if heat has the opposite effect of cold, then if light has any effect, darkness ought to have the opposite effect. I felt it my duty to try, and so I burnt some quantity of magnesium wire near the Radiometer, and it spun round at a great rate. Then I put out the light, and waited for some short time: then striking a light, I looked at the wheel, but, as I expected, it was motionless.

'Light, however, must have some effect on the discs: for place the Radiometer in the window sill, away from anything hot, and the wheel rotates tolerably briskly. Here there is nothing else but the light to make it rotate.

'I next wished to try the effect of the moon's rays. I took the Radiometer into a room with the window open. The moon was shining brightly, and I put the Radiometer on the window sill. It went round for some time the "wrong" way, and then when the temperature of the discs became the same as that of the air, the wheel stopped. I moved it into the rays of the moon; no result. With three mirrors I reflected the light from three different positions on to the discs. So now there was nearly four times the amount of the actual light of the moon cast on to the discs; still

no result; though I did fancy that when I tapped the stand slightly there was a tendency to go round. Moving the Radiometer out of the actual rays, I reflected the light from three positions on to the black disc only; no result. Then on to the white disc only; no result. Therefore the nearest approach that we know of to light without heat had no appreciable effect on the wheel.

'Next I tried colours. First I used the inverted shades, with the space filled with coloured liquids.

'In all the questions of time mentioned below, I used a stop watch. I timed 1 revolution 20 different times, and very curiously and almost unaccountably got different results nearly every time. The shades were covered with a piece of wood and a cloth, so that it could not be likely that the temperature within the shades varied very much. Nor can one suppose that the flickering of the candles could make a difference of 7¼ seconds in rotations under exactly the same circumstances.

'In these cases I used 2 candles, ordinary wax ones, at a distance of 8 inches from the Radiometer.

'With a *red* liquid:

'Slowest time for 1 revolution ... 18¾ seconds.
'Quickest " " ... 13 "
'Average " " ... 15.95 "
'Taken from 20 trials.

'With *purple* liquid:

'Slowest time for 1 revolution ... 18¾ seconds.
'Quickest " " ... 11 "
'Average " " ... 13.437 "
'Taken from 20 trials.

'With *orange* liquid:

'Slowest time for 1 revolution ... 20½ seconds.
'Quickest " " ... 15¾ "
'Average " " ... 17.86 "
'Taken from 20 trials.

'With *pure water*:

'Slowest time for 1 revolution ... 15½ seconds.
'Quickest " " ... 12½ "
'Average " " ... 13.4 "
'Taken from 20 trials.

'With *nothing*:

'Average time for 20 revolutions ... 31.7 seconds.
'Taken from 10 trials.
'Average time for 1 revolution ... 1.585 "

'In the following cases I used 1 ordinary wax candle at 8 in. distance.

'With *red* glass:

'Average time for 1 revolution ... 5 seconds.
'Taken from 5 trials.

'With *yellow* glass:

'Average time for 1 revolution ... $4\frac{3}{10}$ seconds.
'Taken from 5 trials.

'With *green* glass:

'Average time for 1 revolution ... $16\frac{1}{2}$ seconds.

'Taken from 5 trials.

'With *blue* glass:

'Average time for 1 revolution ... $18\frac{4}{5}$ seconds.

'Taken from 5 trials.

'With *purple* glass:

'Average time for 1 revolution ... 5 seconds.

'Taken from 5 trials.

'With *ordinary transparent* glass:

'Average time for 1 revolution ... $4\frac{3}{10}$ seconds.

'Taken from 5 trials.

'I cannot account for the immense difference between green and blue glass, as compared with red, yellow, and purple. It is true red and yellow are the heat end of the spectrum, but it is odd that there should be a difference of 12 seconds between green and yellow. But purple is farthest removed from the heat end, and yet we have the same time. I suppose the purple must have had a great deal of red in it. I could not get good green or blue dyes for the liquid, and so could not try the effect of them.

'From these experiments, one is led to believe that light has nothing or next to nothing to do with the rotation. Still Mr. Crookes maintains that it is only light that affects his form of instrument. In it the discs are of pith, and the arms which support them are glass: so that there is no metal present in his instruments. In this instrument which I show, the arms are of aluminium, the discs of very thin layers of mica.'

The Radiometer is drawn on Plate 6.

Mr. Hutchinson made a few remarks on Mr. Crookes' experiments, and Mr. Wilson explained the theories on the subject given in the *Philosophical Magazine* of March, and the *Bibliothèque Universelle* of January.

G. M. Seabroke (c) exhibited and explained the Siderostat. He had made the instrument himself, and it bore witness to the patience and ingenuity expended on it.

MEETING HELD MARCH 25. (45 present.)

Exhibitions: Large striated block of Limestone, from the Brownsover Drift: Plates of Nebulæ Clusters, &c., from Harvard College, U.S., by Mr. Wilson: also sketches of Alpine Flowers, by himself. A box of Lord Dormer's collection (there were 14 boxes in all). Plates from the coming Report (1875), by the President.

Papers: The Report of the Entomological Section for the year, by H. F. Wilson (M). G. M. Seabroke read the Astronomical Report. These will be found in our Report for 1875.

H. W. Trott (M) read a paper on '*Climbing Plants*,' giving the substance of Darwin's book on the subject.

The President then read the following paper by S. Haslam (c), on '*Fresh Water Aquariums*,' of which the first portion was printed in our Report for 1875.

'Now to say a few words on what to keep in an aquarium. I cannot pretend to speak scientifically of the creatures I am going to tell you of, or the plants either. And as it would take me at least an hour longer to read to you all that I could recollect of what I have *read* on this subject, and even then I should be talking of things I have never seen or kept in an aquarium. I mean to confine myself to things that I myself have actually kept in one, with very rare exceptions, and those only among the plants. Let us go roughly up the scale of living organisms. First, the minute animalculæ, visible or invisible to the naked eye. These you will have to keep, whether you like it or no. They are always there, and do much good. They serve for food to the very small fishes, and what is more, they act like vegetables in giving oxygen to the water: for, unlike other animals, they require more carbon than oxygen to sustain them; and this I state not from my own experience, but from that of Professor Liebig. There are certain little red mud worms that live in the water, building for themselves tubes of mud, and congregating in bunches at the shallow edges of ponds. Some of these I have kept, but the aquarium does not suit them, and though they look tempting, fishes will not always eat them. Of shrimps I have already spoken, and of beetle larvæ and of caddis grubs. I should add to my account of these a few words about my experience of them. A few shrimps are most useful, but they soon die in still water, even if left alone. Why this is I cannot say. They are, however, seldom left alone by the fishes, who like them better than any sort or kind of food. I have seen sticklebacks and minnows especially eat themselves quite foolish on shrimps. A supply of a few shrimps once or twice a week is a very good thing. Beetle larvæ are not interesting generally, except the larva of the large Dyticus or diving beetle; and these are only interesting from their ferocity. They grow in the larva state for three years, until they are nearly if not quite as thick as a lead pencil, and from 2½ to 3 inches long. And anything more Satanic than a full-grown Dyticus larva it would be hard to find in England; a cocktail beetle is a fool to him. And nothing comes amiss to him for food, provided it is animal matter. I have seen a Dyticus larva in its second year of growth eat a minnow an inch and a half long, and the way my tadpoles dis-

appeared that year was a caution, until I found out how they went, and then I kept them somewhere else. The only recommendation I can give them is, that they haven't time to do much harm even if you keep several. I had eighteen once, and in four days there was only one remaining. They had killed and eaten one another. They are interesting, too, from their mode of swimming, which is very graceful, and in this and in their shape they remind one of prawns; and from the fact that they obtain the air they breathe through their tails, or rather through three hollow hairs or spikes situated on their tails. The larvæ of the larger kind of dragon flies are interesting too, but they are also very destructive; so keep only one or two of them. I do not know how long they take to come to maturity. They have two very interesting features—their mode of catching their prey, and their mode of progression. They are provided with a sort of mask under which their jaws are concealed. These jaws are at the end of a sort of arm with an elbow joint in it, and with the mask closed and the elbow only showing like a sort of chin, the creature looks stupid and innocent enough, having a face like a donkey, and being only able to crawl very slowly. But let any hapless grub or even a young fish confide in the innocent-looking greenish-grey donkey-faced larva, and, in vulgar parlance, before he can say knife, up goes the mask, and out come the jaws, and he is caught and leisurely eaten. This larva can only crawl but slowly, but if he is in a hurry or wants to swim from one rock or plant to another, he employs his other curious mechanism; he ejects a stream of water forcibly from his tail, and the kick, so to speak, darts him speedily forward about two inches, and so on again and again until he reaches the desired point. You can only detect the stream of water he ejects by its disturbing particles of sand or dust behind him. I have kept many beetles, and they are all interesting and useful, only they get lost very soon, most of them, in various ways. The large ones have a trick of flying away; so has the pretty little Gyrinus Natator, or whirligig beetle; so has the Notonecta, or water boatman. The large Dyticus is nearly, but not quite, as destructive as his larva. I kept one once that got quite tame, and used to come with the fishes to be fed when I tapped on the glass of the aquarium, and indeed finally whenever I shewed my face; I used to feed him on small shreds of meat (N.B., always give good cooked meat scraped into fibres both to fishes and beetles), and it was great fun to see him swimming about, with his nose out of water, anxiously waiting for his bit. They will also eat flies, and indeed almost anything in the way of animal food. The water boatmen are very amusing, and are best fed on flies. Throw a fly into the water, and the water boatman soon perceives its struggles, and sculls himself up to within half-an-inch, and then with a spring like a spider, he has it clutched in his short forelegs, and thrusting his beak into it, soon drains its vital juices. They only suck the flies dry, however, and then leave them; and the dead bodies should be removed as

soon as possible. If you have, however, any dry land projecting from the surface of your aquarium—and you ought to have—you will soon lose the larger beetles and the boatmen; they will mount on it and dry themselves, and fly away. The whirligig beetles take flight from the water even. Some fishes, too, will eat the smaller kinds of beetles, and sticklebacks, though they will not eat them, will bite them and soon kill them. The same may be said of the pretty little red water spider, of which I cannot say more, for I know no more than that it looks very pretty. The only other water spider I have kept is the diving bell spider, or whatever it is called. It spins an oval hollow web among the roots of plants, and ascending and descending several times carries down each time a bubble of air, and leaves it in its nest, so gradually filling its nest with air, and there it lives; but how it feeds, or how long it lives, I never found out. Tadpoles are very interesting microscope subjects, but not very interesting otherwise. The gradual development into the frog is very interesting to watch; but to ensure the successful accomplishment of this you must keep them by themselves in a separate vessel, for they are eagerly sought after by fishes for food when small, and by beetles and larvæ at all times, and a stickleback is never happier than when he is worrying a tadpole like a terrier would a rat. And even when you keep them by themselves, many of them perish because they are inveterate cannibals; and if one shews the least sickliness, he is at once the centre of a horde of nibbling mouths and wriggling tails. Newts are fairly interesting animals to keep in an aquarium, but you must remember that they are not strictly speaking water animals. Until they are fully developed they are so, and a newt tadpole is prettier than and as interesting as a frog tadpole. But when they are fully developed, they really only live in the water three or four months in the year, and those three or four months expired, it will tax your ingenuity to the utmost to keep your newts in the aquarium, and some fine day he will be wanting, until the next spring, when your house master will probably find him in his cellar, or even in his study, or crawling somewhere about in search of water. In the natural state they lie torpid or nearly so, several of them bundled together in a heap in some thick damp grassy place all the rest of the year when they are not in the water. The male newts, when they do go to the water in the spring, develope a beautiful crested mane all along the head, neck, back, and tail, and assume much brighter and gayer tints, chiefly deep orange and a kind of mother-of-pearl sheen on their tails. There are several kinds of newts. I have only kept two—the large rough one and the smooth newt, Triton cristatus and Lissotriton punctatus.

'Of fishes, those that I myself have kept are—roach, dace, bleak, Prussian carp, golden carp, gudgeon, stone loach, miller's thumb or bullhead, minnow, and stickleback. The roach is a very pretty fish, not easy to catch when small enough to keep in an

aquarium, but very lively and interesting, as well as prettily coloured, and a hardy fish and good feeder. The same may be said of the dace exactly, with two exceptions, first, that he has not the bright colours of the roach, but is equally prettily clad in a complete suit of silver, with a greenish back, and has a more slender and graceful form; second, that he is not *quite* so hardy a fish, and a little more shy. The bleak is a delicate fish, but most beautiful. I have never had more than one, and it lived only a few weeks. They are particularly lively and graceful, having all the dash and boldness of a minnow, with the beautiful silver colouring of a dace. The Prussian carp is a dull coloured fish when you first take him from his native pool, for he frequents dark and stagnant holes, but he soon gets brighter in an aquarium, and almost more readily than any other fish takes his colour from his surroundings. I have often turned some nearly all silvery white by keeping them in an ordinary goldfish globe standing on white paper, while I had others in my aquarium a beautiful rich bronze. This is the natural colour of the fish, I think. He is a slow, dull, gaby-faced fish, whose recommendations are that he is easily caught, easily fed, and easily tamed. I have had some so tame as to come and swim into my hand when I dipped it into my aquarium, and lie there to be scratched, and even let me lift them out without a kick or struggle. It is not good for them to do this very often though. In feeding your fish, you should take especial care that they (the carp) get their share, or else the minnows and sticklebacks will take it almost out of their very mouths. Of golden carp or gold fish little need be said. I would only warn you against keeping carp and sticklebacks in the same aquarium; the latter will not be long before they simply riddle the tails and fins of the former, and will finally bite the tails off piece by piece until there is none remaining. The gudgeon is a pretty fish, of a silvery colour, shot and tinged in various ways with rich purple. He is not an interesting fish to keep, being too fond of the ground, but I believe him to be easily tamed and hardy. The stone loach is a plain fish of a yellowish grey colour, mottled and spotted with black. He is a very amusing fish in an aquarium, though somewhat delicate. He is a blundering clumsy fellow, and simply a savage if you see him at his food, a perfectly inert loglike lump if you see him at rest, and yet, in his undulating motions while swimming with his pectoral fins expanded, looks more like a graceful eel with a frill than anything else. At his food he is simply a glutton; as soon as the food reaches the ground, he seems rather to smell it than to see it, and goes blundering and grubbing savagely about with his feelers or barbs spread abroad, and will even pursue other fishes and newts, and make grabs at a worm that may be hanging from their mouths. And to see two loaches wrestling for a worm which each has hold of one end, is a most laughable sight. The loach soon feels the least stagnation in the water of an aquarium, and you need never be

surprised to find in the early morning your loach floating belly upwards at the top of the water. He is not at all generally dead the first time, or even the second, and will dive down again on being startled. But you should take warning, and freshen your water somehow, or else transfer your loach to a less crowded tank, or else it will die, and this you are bound to prevent by all the means in your power. The miller's thumb or bullhead is a hideous fish, even more plainly coloured than the loach at first sight, though a closer inspection will reveal great beauties in this fish. He has a most disproportionately large squat head, like a toad's, with a frightful slit for mouth, great fan-like pectoral fins, with claws or something very like them, and a straight small body with an outline as stiff as a piece of wood. But his mottlings are very delicate and beautifully shaded, and the eye in many lights has precisely the appearance of an opal, flashing red, and green, and blue, and pearl colour, all at once or separately. There is no gracefulness of motion about him, however. He lies at the bottom generally all day, or rarely moves about, only from under one stone to another, and waits for his food to come by. Then you suddenly see his head pricked up, his eyes flash fresh colour, and with a flap of his great pectoral fins, he makes a shot at the bit of meat or worm, or even a young fish if it venture too near. If he gets it, and he generally does, well and good, he then gorges it at leisure; if not, equally well and good, he sits down and waits for another. He very seldom tries again at the same bit. He, too, is a very delicate fish, and indeed, to succeed well with the loach and bullhead, you must have a cistern, tap, and waste pipe to your aquarium, and so be able to keep a fresh stream of water running into the aquarium for some hours every week, if not every day. The minnow is a fish that you *must* have. An aquarium without a minnow is a gilded sham. He is a delightful fish, beautifully coloured, with all the beauty almost of a mackerel, all the grace and boldness of a trout, and nearly as easily tamed as a Prussian carp. They will rise to flies and any food floating on the surface, exactly like a trout, and are perpetually on the move, up and down and backwards and forwards, all day. In the breeding season (June or late May), minnows increase much in gaiety of colour, green and bronze and silver, and the males are streaked with red about the mouth and throat. The male minnow is the only fish that will engage in combat with the stickleback, and by dint of butting him, will often obtain a temporary advantage over him. Minnows will eat almost any food you can give them.

'Now we come to the stickleback. If an aquarium without a minnow is a gilded sham, an aquarium-keeper that has never kept a stickleback is in a truly deplorable state. This fish is to other fishes as a terrier is to other dogs. Neatly and compactly built, magnificently coloured in the breeding season, and beautiful all the year round, quick, impetuous, plucky, sagacious, most tame-able, and yet ready at once to resent any undue familiarity; with

the underhung jaw and the pertinacity of a bulldog, and displaying in the breeding season the most wonderful patience, tenderness, and paternal affection to his young, mixed with an almost ludicrous fury and shortness of temper to everything else; no wonder that he is an universal favourite when kept in a tank by himself, or large enough to give others a chance of escape from him, and an universal pest when kept in a small tank with others. Many sticklebacks have I kept, and many and many a page could I fill with stories of them, but I am keeping you too long already, I fear. Suffice it now to say that they are as mischievous as monkeys, as intelligent and plucky as terriers, and when properly kept by themselves as loveable as any pet in the whole animal kingdom. They possess more variety of feature and character than any fish at all, not excepting minnows, who rank next. And a battle royal between two male sticklebacks in the breeding season, such as I have sometimes witnessed, would require the pen of Homer to describe. There are several kinds of sticklebacks, distinguished chiefly by the number of spines on their backs. The three commonest are the three-spined, the ten-spined, and the fifteen-spined. The last is a salt water fish by rights, but one peculiarity of this fish is that the fresh water kinds will soon accustom themselves to salt water, and *vice versa*, nearly always. They build nests for the females to lay the eggs in, and the male undertakes the entire care of the family from the time that the eggs are laid to the time that the young are fit to shift for themselves. It is almost impossible to keep them so as to succeed in rearing the young. They generally die off in about a fortnight, but with a running tap I once succeeded in getting six or seven out of a nestful to about the size of an inch, and then the aquarium got frozen, or somehow they came to an untimely end. There are two other fishes I have kept in aquariums, the pike, and the perch. These are inveterate cannibals, and it is very difficult to get them so small that they will not or cannot eat your other fishes. And however small you get them at first they soon grow large enough to *try*, if they don't succeed, to eat any fish not quite so big as themselves. Hence you will soon find your fish disappear one by one, or even faster, or else you will find them getting mangled and bitten about the tail and fins. Now to plants. The best plants are Vallisneria spiralis, Water Crowfoot (Ranunculus aquatilis), Watercress (Nasturtium officinale), Water milfoil (Myriophyllum spicatum), Brooklime (Veronica beccabunga), Water starwort (Callitriche verna), Water thyme (Anacharis alsinastrum), whereby hangs a tale, Frogbit (Hydrocharis morsusranæ), Water soldier (Stratiotes aloides). The duckweeds (Lemna, especially trisulca, minor, and polyrhiza), and three or four kinds of pond-weed (Potamogeton pectinatus, fennel-leaved, densus, opposite-leaved, gramineus, grassy, crispus, curly-leaved, and fluitans, floating). All these I have kept except Frogbit, Water soldier, which is rarer than the rest, and the pondweeds except pectinatus. I can recommend no other plants at all.'

The President expressed his intention of starting an Aquarium, if possible.

MEETING HELD APRIL 8. (39 present.)

The President announced that Mr. Haslam had lent his valuable aquarium to the Society, and expressed a hope that he might induce him not to require it again.

(Owing to Mr. Haslam's great generosity this hope has been fulfilled.)

The President read a note from C. M. Cunliffe (A) about the rooks' nests in the Close. The numbers were as follows:—

1873	...	...	...	89
1874	...	...	...	90
1875	...	...	...	109
1876 (up to this date)			...	107

Mr. Cumming (H) read a note on the peculiar growth of trees in Norway: and shewed a drawing of a spiral trunk, suggesting that it was a natural protection against wind, as the spiral fibres were less liable to snap.

Exhibitions: Photographs of Antlers, Skins, etc., sent by F. C. Selous (C) from Africa, by Mr. Wilson, who gave a lively account of Selous' doings when a Member of the Society.

Papers: The President read the following paper on '*Ants*,' by F. C. Houghton.

'During last summer I was led, by the presence of several colonies of ants in a garden, to make some inquiry into the instinct and "mental powers" (if I may so term it) of these animals. I had intended continuing my observations and further testing the truth of the conclusions I had come to, but the papers of Sir John Lubbock (on Ants, Bees and Wasps) read since then before the Linnean Society, have rendered this unnecessary. The colony of ants I experimented on was one of the common black ant (F. fuscus). The neuters, I observed, were of two sizes; the largest having, in addition to other minor differences, the mandibles more largely developed: these would, I believe, be termed *soldiers*, although I was unable to detect them in the performance of any soldier-like functions. The other smaller neuters would be called *workers*. The colony in question had established itself on the two sides of a gravel walk—the "nests" being excavated in the untrodden gravel at the sides and continued into the soil on both sides. A continual

stream of ants was passing across from one nest to the other, many of them often bearing in their mandibles the dead or living body of some insect-prey, chiefly the larvæ of the common "Frog-hopper" (Aphrophora Spumaria),—this generally living, but always minus three or four legs—aphides, also living; and flies of all sorts and sizes—often only heads. I have more than once, too, seen two small ants lugging a refractory young millepede (Fulcus terrestris) fully half-an-inch long. Their surprising powers of strength and perseverance were well exhibited one day, when, having mutilated the wings of a large humble bee, I pushed it into the nest: a number of ants instantly attacked the intruder, by seizing its legs in their mandibles and keeping them fixed to the ground. From time to time the bee would release a leg, and carrying it to his mouth with the ants still clinging to it would kill them with a sharp bite. Several times it nearly got free, but the two or three ants that still clung to it so impeded its movements that it was unable to escape, and at the end of about ten minutes was overpowered and slain after having put twenty-seven of its assailants "hors de combat." In an hour's time the outer shell was all that was left of it. I noticed that it never once tried to use its sting. I have not succeeded in rousing their ire by the intrusion of any other insect, so whether they knew the sweet feast that was in store for them if they mastered the bee, or whether they despised the other beasts, seems uncertain.

'With regard to their powers of communicating with one another, I made the following experiments.

'1. I placed a small quantity of brown sugar in the centre of the walk, not so much in the line of march as to attract all passers, but sufficiently so as to be in the way of stragglers. In a short time one or two stragglers came upon the heap and immediately began to feast on the sweet morsels, stroking the crystals with their antennæ, just as they do the aphides when they want them to exude the Honey-dew.* Having satisfied their appetites they went on their way, but did not, to all appearance, communicate their "find" to their less fortunate fellows; for during the whole time—and I watched from one to three hours each experiment—the only ants who touched the sugar were stragglers from the main body, and these few and far between. (That they are fond of sugar is well known, and I proved it by placing some in the line of march, when every ant that came in contact with it stayed and eat.) I was thus led to conclude either that they were very selfish, or that they had not the power of *communicating* with one another.

'2. I had observed that they find their way neither by sight nor as I believe by scent (of this more anon), but by *touch* or some analogous sense: so I placed in the general track a thin sprinkling of coarse sand about three inches broad, not so thickly as to cover the surface, but so as, in a minute way, to alter its configuration—

* With regard to this motion of the antennæ, I notice that it is made *whenever* they are eating any food they particularly enjoy; so whether it is inherited instinct from their habit of "milking" the aphides, or a natural expression of pleasure, seems doubtful.

this I did when but few ants were passing. On coming to the place they seemed puzzled, went back, went partly round it, wandered all over it, touching the ground with their antennæ all the while, till at length one more lucky than the rest struck the track on the other side. (I may mention that there were ants attempting the passage from both sides.) In time they got across, a few at once; and being enabled to distinguish a few individuals, I noticed that on their return they passed without difficulty over the new ground, *but that they did not in any way communicate with their still puzzled comrades, who, for their part, did not attempt to follow them.* This experiment I repeated several times.

'3. Placing a leaf with some aphides on in the way of a straggler some distance from the main road, I observed that he seized one and went off with it to the "nest," and returning twice took two more, *but brought no other with him.* (As I suppose these aphides would be for the common good, this experiment seems to rebut the charge of selfishness in the first experiment.) This experiment I repeated three times.

'That they have some means of communicating with one another is evident when we see the systematic way in which they go to work in everything, and from what I have seen I have been led to believe that the large neuters (soldiers) have the power of communicating with the smaller neuters (workers), and with each other, by certain movements of the antennæ, but that the workers have *not* the power of inter-communication—a special provision, no doubt, to prevent them wasting their time in talking when they ought to be working. (Among other incidents that have led me to this belief, I might state that I have seen a soldier pass his antennæ over several workers he came across, and they have stopped to repair some damage in the place. This however requires more investigation. With regard to powers of *scent* and *vision*: I find that the soldiers have larger eyes than the workers, whose eyes do not appear indeed to be of any use, and are in fact in a rudimentary state. As to whether the soldiers have the power of vision, I was unable to determine satisfactorily. As regards *scent*, I have failed to notice that they possess that faculty. I have seen them pass sugar heaps, honey, etc., a distance of a quarter-of an inch without turning aside. That they do not make their way by scent, but by touch, will be obvious, I think, when I state that on placing a few large grains of sand, or picking up the ground with a penknife, so as to alter the configuration of its surface, they quite lost their way, although I had not disturbed the ground enough to destroy any scent it might have.

'In conclusion, I may mention that my observations were made, and this account written, before I had seen or heard of any account of Sir J. Lubbock's experiments.'

The President made some remarks on the subject.

MEETING HELD MAY 20. (68 present.)

Exhibition: Salmon roe, by Mr. Gillson.

Papers: A note on the Aquarium, by C. Bayley (M). Some remarks were made about certain injuries which had been done to the Aquarium and its inmates.

An anonymous paper on '*Birds*' was then read by the President, from which we extract the following.

'In a certain garden belonging to a certain house lies a family vault for birds. In that family vault there lie eight once beautiful canaries—but now no longer so—, two larks, two thrushes, two goldfinches, one poor wretch which had no name, but was a combination of all birds in general, and two sparrows, which I am afraid would never have been taken care of at all if it had not been for the delusion that they were going to turn out wonderfully fine specimens of some wonderful kind of bird.

'To particularise upon all my birds would be too severe a tax upon my memory, therefore I will describe those which I loved most, and which had the best dispositions and cleverest little minds; for you must know birds have dispositions and minds—at least mine had; some were clever, and some stupid, some loveable, and some too sulky to say even "good morning" to you.

'Nearly all my birds have been of a loveable nature, except one, who for some domestic reason or other hated his wife; possibly it was because he was bright yellow and she was all green, but if she was green outwardly he was much the greenest inwardly; for if you mewed like a cat he was taken in and thought his last moment had come, whereas Mrs. Toby, his wife, sat perfectly still and composed.

'Well, one morning four eggs were seen in Mrs. Toby's nest, but out of the four eggs only one little bird came to life, and this poor little innocent was the cause of all the family quarrels which began at five in the morning and went on—till they stopped. Master Toby had eggs for breakfast, but the parental authorities even squabbled who was to feed him, and so between them they eat it up or lost it: till at last, one day, when after high words they came to blows, it was thought advisable to put the youngster in a separate division of the cage, fearing that he might be asked to "stand second" to one of them. But, alas! this last brawl had been too much for Mrs. Toby: the next day she fell off her perch in an apoplectic fit, and was never heard to speak again. The heartless Mr. Toby, directly he found out that she was quite dead, yelled a yell of great delight, and sang as he had never sung before; he then peeped through the bars at his son Tom, told him the good news, whereat this noble youth, who was sitting in deep thought on his perch, did not move one muscle of his face, but nodded his

head with imperturbable gravity, and fell asleep. The father, thinking him cracked, turned away in disgust, and began his mid-day meal with greater relish than ever. Mr. Toby's opinion about his son being cracked is rather true, for he is decidedly light-headed; he has never yet learned to stand on one leg, or to say good-morning. Mr. Toby died a martyr's death: whether it was that he was taken all of a sudden with repentance for his treatment of Mrs. Toby, I do not know, but certain it is that one morning, his cage door being open, seeing a bright fire burning, he thought to himself "now or never," so out he flew on to a burning hot coal, gave one shriek, and expired. Thus poor Tom was an orphan, but I cannot say he seemed deeply afflicted; at the time his poor father gave his last shriek he was taking his bath; he only looked round once, then continued his ablutions with his usual gravity.

'I must now tell you a little about Tom's relations. His greatest friend was his maiden aunt, Miss Alltail, so called because she had no tail; this lady had been devoted all her life to a state of celibacy, which I think on the whole was a good thing, for being rather an eccentric person it would certainly have driven any rational being wild to live with her. One of her great peculiarities was, she expected any day to see her tail appear whole, and so every morning round and round her cage she strutted, with her head the wrong way, looking for the coming tail; but the tail was obstinate, it would *not* come; if it had come Miss Alltail might have been still alive and flourishing, but when she one day suddenly realized the awful fact that a tail never meant to come to her, she stood on one leg, turned up her eyes, and died broken hearted.

'And so another member of the family was added to the family vault.

'After the lapse of a short time when every one had partially recovered from this sad event, a visitor was introduced of the name of Von Moltke, by nature a bullfinch, who came of a very good old family, people say as old as the world, but that is not known for certain. But it is a fact that he was the most troublesome young gentleman imaginable, for he had every conceivable and inconceivable bad habit. One was, all day long, at every few minutes, he gave a most melancholy wail or screech,—this was not because he was unhappy, for he had every luxury. To break him of this habit he was put into a small cage, just big enough not to hold him comfortably, every morning till he was good; for a time it succeeded, for whenever he saw the small prison glimmering in the distance he stopped his wailing. But Moltke had so many other bad ways, and was altogether such a very unsociable being, that after a stay of six weeks he was sent home as incorrigible. What has become of him, and whether he is alive, I do not know.

'I have had one bad case of henpecking in this family of mine. One young couple, called among their own circle "Long Poll" and "Short Jack," could not manage at all to hit it off together; they squabbled about anything and everything, but Short Jack always

came off worst, particularly at building time, when Long Poll was more peevish than usual; she used to follow him round the cage, pulling feathers out of his tail or anywhere where she could, till poor Jack shivered with cold. If he appealed to any neighbours for help or sympathy, they only shook their heads gravely and reproved him for taking any one above his fighting weight.

'After one very long feather had one day been cruelly extracted, it was thought necessary to obtain a divorce and part this uncongenial couple. This was done, and I am not sorry to add that Long Poll expired quietly one morning; it is not known why, but it is thought that the day before she had had a closer view of Mrs. Puss than she quite liked.

'Short Jack, delighted to find himself free, and no longer a poor, despised, henpecked man, began to think that after all life was not so bad; so he lived on to a good old age, till at last he took it into his head that his room was better for his friends than his company. Short Jack never entered the family vault, for after his death he was taken to a place where they make dead birds look alive, and every day he stares at me in a reproving manner with two great black glassy eyes, as much as to say, "Why am I sitting perched up here as if I were alive." His greatest visitor is Mrs. Puss; she, poor deluded being, thinks he still lives, and so comes nearly everyday, eats a little bit of him, and then plays with him, no doubt thinking him a most considerate bird to be so obedient to her commands.

'The last little canary that I took under my protecting care was Chinkie; he was the Benjamin of the family, and could do everything and anything. He would stand on your finger as long as you liked, say "yes" and "no" when spoken to, sing, jump, and whatever else you wished. But, as everything has an end, so had poor Chinkie; he, vain little bird, thinking he could take care of himself, and wishing to explore the great outer world, one day when walking on the table, the window being open by mistake, he flew out and never was seen or heard of more.

'It is not improbable that after a few short hours of bliss, he made a nice dainty dish for a small cats' tea-party.

'Thus ends the histories of Mr. and Mrs. Toby, Miss Alltail, Von Moltke, Long Poll, Short Jack, and lastly, little Chinkie.

'Poor Tom still lives on in his quiet and hum-drum way.'

The following paper on the '*Geology of Charnwood Forest,*' near Leicester, was then read by the Rev. T. N. Hutchinson.

'The district of Charnwood Forest lies between the three towns of Leicester, Ashby-de-la-Zouch, and Loughborough, extending about ten miles in length from east to west, and from six to seven in breadth from north to south. It formed part of the ancient forest of Arden, which occupied a portion of England from the Avon to the Trent, and although it certainly has not much claim to the title of forest at the present time, yet many names existing in

the locality, such as Woodlands, Woodthorpe, the Outwoods Timberwood, and Charnwood itself, are at least suggestive of a period when this part of the country presented a more forest-like appearance.

'A sketch map shewing the places referred to in this paper is given in Plate 1.

'Geologically speaking, the district consists of a series of rocks ranging from true slates to hornblendic granite and syenite as the extremes, but including between these limits a remarkable variety of altered slates and grits, volcanic ashes, breccias, and agglomerates, all more or less highly altered, with here and there bosses, veins, or dykes of so-called "greenstone" (or diorite) and felstone.

'A large portion of the rocks are simply called "porphyries" in the memoirs of the Geological Survey, but this word in reality only describes an accidental variety of structure, and any rock which contains distinct crystals embedded in a more or less compact matrix might be called "a porphyry," or better, a "porphyritic rock."

'There is good reason, however, for believing that these so-called porphyries are only sedimentary deposits that have been subjected to intense metamorphism.

'The rocks of this miniature mountain range, as it has been called, present in some places a really striking appearance, rising suddenly and abruptly out of the level plains of the new red sandstone and marl by which they are surrounded.

'Speaking generally the hilly ground runs nearly N.N.W. and S.S.E. The two highest points are Beacon Hill and Bardon Hill, each of which rises about 850 feet above the sea, and about 700 feet above the level of the Soar at Leicester. The ground in the immediate neighbourhood of Bardon Hill, however, is itself more than 500 feet above the sea level, so that the actual rise of the hill is not considerable.

'On the N.W. of the district patches of mountain limestone occur, sometimes dolomitized, as at Grace Dieu, and further west still lie the coal fields of Ashby and Coleorton. On the N.E. is the lias.

'Hornblendic granite occurs only in the neighbourhood of Mount Sorrel. The chief masses of syenite extend between Groby, Bradgate Park, and Markfield, while the finest examples of altered rock are to be found in the district of the so-called porphyries, lying between Grace Dieu and Green Hill.

'The slate rocks on the whole are found to dip to the S.W. and N.E. on either side of an anticlinal axis, the direction of which extends from Whitehorse Wood to Holgate Lodge. Along the line itself the beds are nearly vertical.

'As no fossils or traces of organic life have yet been discovered in the slates, except some obscure markings in the quarries at Swithland, supposed by Mr. Ramsay to be the impressions of sea-

weeds lying in the wash of the tide, it is impossible to determine their age with anything like certainty. They have hitherto been referred, on purely lithological grounds, to the Cambrian Period, as on the whole most resembling the Welsh rocks. The Rev. T. G. Bonney, however, considers that in general character they come nearer to the so-called "Green slates and Porphyry series" of the English Lake district. If so they would be of Lower Silurian age. Mr. Bonney has pointed out that the strike of the Green slates of the Lake district when last seen to the S.E. is about W.N.W., which corresponds nearly with the Charnwood strike.

'The slate rocks vary from a fine grained roofing slate to a coarse gritty conglomerate. There are quarries near Swithland and on the road between Groby and Markfield. Only one of the Swithland quarries is now worked. It is situated in a wood and is a picturesque and striking object, the slates dipping sheer down to a depth of about 180 feet, at a very steep angle.

'The grain is fine, and the slates are much used in the county for roofing and other purposes, but the cleavage is not nearly so perfect as that of the Welsh slates, although, as I was informed at the quarry, "the durability is ten times greater." Some of the Groby slate is also used for roofing, but more generally for cisterns, tombstones, troughs, and paving flags. In the waste heaps round the Swithland quarry may be found hand specimens, shewing veins of quartz, felspar, and chlorite traversing the slate in all directions.

'The slates frequently alternate with fine or coarse grit, and sometimes with volcanic ashes, and the stripe is then well defined. At Swithland and near Groby it is faint, at Beacon Hill it is clear. In some cases the slate is highly indurated and porcelainized, in fact, here and there converted into hornstone. Beds of ashy slate, more or less altered, occur throughout the district. I have two or three specimens shewing very distinctly the alternate layers of ash and ordinary clay slate.

'There are good examples of altered ashy slates at Billa Barrow and White Hill, between Bardon and Markfield. On the right hand side of the road, about half-a-mile out of Markfield, towards Bardon Station, are some picturesque rocks composed chiefly of coarse altered ashy slate, with volcanic breccias and agglomerates.

'The Rice rocks nearer to Bardon Hill are of a somewhat similar character.

'Bardon Hill itself presents quite a series of geological puzzles in its different parts. The whole is coloured crimson and called "Greenstone" in the Ordnance map, but this is certainly incorrect. Probably at the time the Survey was made only small portions of the hill had been exposed. Now extensive quarries are worked on the north side, but it is by no means easy to make out its history. In approaching the lower quarry there is an unmistakeable belt of highly altered ashy slate, converted in parts into mere shale with some talcose schist. After passing this we come upon beds of volcanic breccias and variously altered rock till we reach the beds

of which the heart of the quarries is composed. Hand specimens from these parts present all the appearance of true crystalline igneous rocks, and might well pass for felstone or quartz felsite: but on the other hand there is no appearance of intrusion on the part of such rocks, and hence it is more than probable that their present state has been produced by intense metamorphism, that is, by the action of heat and pressure upon the neighbouring beds, which have thus passed by insensible gradations into rocks which, if examined by themselves, would certainly be called igneous.

'I have carried away a series of specimens that I think will be found to illustrate this statement. It will be seen that in some all trace of original structure has disappeared, owing to partial, or possibly total, fusion, while in others signs of stratification and bedding point to their sedimentary origin.

'The porphyritic rocks between Grace Dieu and Green Hill afford still more striking examples of extreme alteration, and here there is still less room for doubt as to the metamorphic action by which they have been reduced to their present state.

'This district extends about two-and-a-half miles from N.W. to S.E., with an average breadth of something less than a mile. It comprehends the rocks or crags known as High Cademan, High Sharpley, Ratchet Hill, Peldar Tor, and Green Hill.

'Mr. Hull, in his memoir on the Leicestershire Coal Field, describes these rocks as "a series of bedded porphyries contemporaneous with the Cambrian rocks themselves." He considers that they "were poured out as lava on the bed of the ocean, and so assumed the stratified arrangement of the aqueous rocks with which they are associated."

'The Rev. W. H. Coleman, however, one of the earliest and most zealous workers in the district, observes, "The general character of the rock in this quarter is such as to convey irresistibly the impression that it is nothing else than the slate itself heated to the meeting point and then crystallised by cooling. It rarely appears to have been in a thoroughly fluid condition so as to have flowed like lava." Traces of the original bedding are sometimes quite evident, as is the case especially about Peldar Tor.

'Perhaps the greatest variety in the character of these altered rocks is to be observed between Green Hill and Peldar Tor. Here I found, in fact, a complete Geological (or Petrological) Museum, only with the objects on a larger and grander scale, exhibiting almost every phase of metamorphism. Hand specimens may be obtained, as remarked by Mr. Jukes, "not three inches across, one side of which will be a slate rock of the finest grain and with no appearance of crystallization, while the other is a perfect congeries of small crystals; and there is frequently a gradation from one into the other, a few detached crystals first appearing in the slate and gradually becoming more numerous on one side and disappearing on the other." I was fortunate enough to carry away two or three such specimens myself.

'With regard to the origin of the granite and syenites, it is much more difficult to speculate. One thing at least seems to be certain, that they are at all events as old as, if not older than, the slate rocks themselves, since such rocks as are in their immediate neighbourhood shew not the slightest trace of local disturbance, and no syenite is to be found along the anticlinal line of the forest. It is also to be remarked that the junction of the syenite with the slates is no where exposed, while at various places, as at Hammercliff Hill and elsewhere, the so-called porphyries pass into syenite with such an apparently imperceptible gradation, as would force us to believe them at least to have been produced at the same time, and to be parts of the same mass of melted matter, assuming different forms according to slight modifications in its conditions of cooling. I certainly found some portions of the rock at Bardon Hill that seemed to pass into what was, to say the least, very near akin to the syenite of Groby and Markfield.

'I will now give in detail the results of a microscopical examination of some of the crystalline rocks, thin sections of which I have had cut from characteristic specimens. The drawings have been made with great care by the aid of a "Neutral tint reflector," a little instrument not much known but at least as efficient as the more expensive "Camera lucida." I will take first the Groby syenite, sections of which are shewn in figs. 1, 2, 3, Plate II. It is composed of quartz, felspar, and hornblende, with variable quantities of magnetite, apatite, and occasionally epidote. The felspar appears to be chiefly orthoclase. I have examined five sections taken from different parts of the quarries, and there are only here and there crystals shewing the characteristic striæ of plagioclase. The felspar is much decomposed, many of the crystals being entirely converted into a dark greyish opaque substance. In some instances the products of decomposition occupy only the central portion of the crystal, leaving a clear distinct border of unaltered felspar all round. Twin crystals of orthoclase abound, the one half of the crystal being sometimes almost entirely occupied with opaque matter, while the other half has only a few slight dendritic markings shewing the commencement of alteration. A fine twin crystal of this description is shewn in fig. 3, Plate II.

'The apatite, or phosphate of calcium, occurs in long acicular hexagonal prisms—they are often very fine, and only come out well under a high power.

'The epidote is found in nests and veins, its peculiar green colour being quite unmistakeable. It is occasionally well crystallised, and shews splendid colours under the polariscope. The magnetite occurs in the usual black and perfectly opaque grains, seldom in definite crystalline forms.

'The hornblende is mostly of a greenish tint and is often much altered. Some of the leafy and rosette-like figures that are conspicuous in all the sections are probably due to the decomposition

of hornblende. Here and there I thought I recognised chlorite, or some chloritic mineral.

'The syenite at Markfield is almost identical with that of Groby. In some parts of the quarry it is rather coarser and with a larger proportion of red felspar. It is very variable however, and may be found, in places, of a dark greenish grey colour with hardly any felspar. It is frequently highly decomposed, and the hornblende partly replaced by a pale greenish yellow epidote. Veins of calcite occur in parts of the quarry. A section of Markfield syenite is shewn in fig. 2, Plate II.

'The Mount Sorrel rock is a hornblendic or syenitic granite, containing hornblende as well as the ordinary components of a true granite, quartz, felspar, and mica. There are two varieties in the quarry, pink or red, and grey. The hornblende is generally of a greenish tint, and is not so much altered as at Markfield and Groby. The mica is dark, nearly black, but appearing brown or yellowish brown in their sections under the microscope. It is strongly dichroic and is probably biotite, that is, magnesian mica. It is difficult sometimes to distinguish it from the hornblende, which is also occasionally of a yellowish brown colour, and also dichroic. There are crystals of magnetite, and here and there nests of iron pyrites. Sections of the Mount Sorrel rock are shewn in figs. 5, 6, 7, 8, 9, Plates II. and III. The felspar is of two kinds, orthoclase and a triclinic variety, probably oligoclase. The red colour of the rock is due to orthoclase. The crystals are often greatly decomposed and are sometimes entirely filled with a grey or reddish grey opaque powder. Frequently, however, as in the Groby crystals, the decomposition has been confined to the central portions, the outline of the crystal being traced by a band of clear transparent unaltered felspar. Probably in many cases the result of the decomposition is simply kaolin, or pure clay, that is silicate of alumina; the appearance however is sometimes such as to suggest that the crystals are converted into chloritic pseudomorphs. A good example of these decomposed crystals is shewn in fig. 7, Plate III.

'The triclinic, or plagioclase, felspar is more abundant in the grey portions of the Mount Sorrel rock than in the red, as might be expected. The crystals generally are less decomposed, and the striations in some cases are very sharp and clear, shewing splendid colours under the polariscope. A typical specimen exhibiting both varieties is seen in fig. 8, Plate III. The crystal in the upper part of the section is probably oligoclase, with well-defined parallel striæ: this is quite unaltered. The crystal on the right and the lower one in the centre are also triclinic felspars, but with less regular striæ, and more or less decomposed. The other crystals are orthoclase with specks of magnetite and a little fibrous hornblende. The portion on the right is quartz. Fig. 6, Plate II. shews another section of the grey granite with triclinic felspar, quartz, mica, specks of magnetite and dark green hornblende.

'The striæ of the triclinic felspars is due to their peculiar laminated structure, the crystals being built up as it were by a series of thin plates varying in thickness. Sometimes there appears to be a kind of intergrowth of the two varieties, striated and non-striated crystals fading away almost imperceptibly into each other. In other cases, the laminated structure is not continuous throughout the length of the prism, nor are the laminæ all of the same length themselves. A good example is shewn in fig. 9, Plate III., which exhibits a felspar crystal in the grey granite from Mount Sorrel. In all the sections of the Mount Sorrel granite the spaces between the other minerals are filled up by quartz which is particularly rich in fluid cavities, indicating, according to Mr. Sorby's views, that the rock was consolidated under great pressure.

'In the quarries are several veins of felstone, with a much decomposed crumbling rock between it and the granite. A portion of this is covered with a superficial coating of a blue substance which I have ascertained to be phosphate of iron, in fact, an earthy variety of the mineral vivianite. The quarrymen call it "blue rock," or "blue stone." There are also narrow veins of red hæmatite iron ore with quartz running east and west, in the same direction with the veins of felstone. The hæmatite occurs in radiated fibrous and reniform masses, very similar to the Ulverstone iron ore. Small quantities of crystallised galena, iron pyrites, epidote, and fluor spar are to be found in different parts of the quarry.

'The rock at Kinchley Hill, between Mount Sorrel and Brazil Wood, is composed partly of hornblendic granite and partly of syenite.

'Just on the outskirts of Brazil Wood, on the footpath road to Swithland, there are bosses of igneous rock on either side of the road. The one on the left from Mount Sorrel is syenite. That on the right is a true greenstone or diorite. This is of some interest, as there are not many specimens of undoubted diorite in the Charnwood Forest district. Its existence was pointed out to me by Mr. Bonney. Under the microscope the rock is at once seen to consist of hornblende and plagioclase felspar, with abundance of characteristic striæ. Externally it is a dark, rather coarsely crystalline rock. In fig. 10, Plate III., I have attempted to shew the appearance presented by a section under the polarizing microscope.

'On the other side of the footpath near to the boss of syenite is a very interesting quarry of contorted gneiss, the only rock of this kind in the district, so far as I know. In a hand specimen it is perhaps difficult to recognise the foliated character of the rock, but on the larger scale it is apparent at once.

'It is worth remarking that at this spot, within a few dozen yards of each other, we have gneiss, syenite, and diorite, while only a little further off, at Kinchley Hill, the syenite passes into hornblendic granite.

'*Description of Plates.*

'Plate I.

'Sketch map of the Charnwood Forest District.

'Plate II.

'Fig. 1. Syenite from Groby. Seen by polarized light, × 9 diameters. Crystals of felspar, some triclinic; green hornblende; leafy and rosette-like forms due to decomposition products; very little quartz; specks of magnetite.

'Fig. 2. Syenite from Groby. Seen by ordinary light, × 9 diameters. Dark hornblende; orthoclase felspar and decomposition products; small amount of quartz; much pale yellowish green epidote.

'Fig. 3. Syenite from Groby. Seen by polarized light, × 25 diameters. Fine twin crystal of orthoclase undergoing alteration; acicular crystals of apatite; decomposed hornblende, &c.

'Fig. 4. Syenite from Markfield. Seen by ordinary light, × 9 diameters. Highly altered. Orthoclase felspar; greenish hornblende, and much epidote.

'Fig. 5. Grey hornblendic granite, from Mount Sorrel. Seen by ordinary light, × 9 diameters. Green hornblende; felspar, chiefly orthoclase; brownish black mica; quartz, and specks of magnetite.

'Fig. 6. Grey hornblendic granite, from Mount Sorrel. Seen by polarized light, × 9 diameters. Dark hornblende; triclinic felspar, with some orthoclase; dark brown mica, quartz, and magnetite.

'Plate III.

'Fig. 7. Red hornblendic granite, from Mount Sorrel. Seen by polarized light, × 9 diameters. Shewing crystals of orthoclase felspar undergoing alteration.

'Fig. 8. Grey hornblendic granite, from Mount Sorrel. Seen by polarized light, × 9 diameters. Shewing fine triclinic felspar crystal in upper part.

'Fig. 9. Grey hornblendic granite, from Mount Sorrel. Seen by polarized light, × 25 diameters. Crystal of triclinic felspar with discontinuous striæ.

'Fig. 10. Diorite, from Brazil Wood. Seen by polarized light, × 9 diameters. Hornblende and triclinic felspar.

'Fig. 11. Rock from Bardon Hill, upper quarry. Seen by polarized light, × 9 diameters. Felsitic base, with large, imperfect, much altered crystals of felspar, and numerous small crystals and grains of epidote scattered throughout the whole; small specks of hornblende, magnetite, &c.

'Fig. 12. Portion of the same. × 25 diameters.'

MEETING HELD JUNE 3. (76 present.)

Exhibitions: Tiger skull from India, (presented) by Colonel Carleton. Primitive flint Celt from Norfolk: inscription from an

address by an Elamite king: by M. H. Bloxam (O.R.), who also exhibited a tusk found in his own garden. Bulrush bored by *Nonagria typhæ*, by Mr. Cumming (H).

A burying beetle was also exhibited, whose habits were explained in a few words by M. J. Michael (M).

H. F. Newall exhibited Tisley's Compound Pendulum apparatus, constructed by himself, also curves drawn by it. He likewise exhibited a modified form of Mr. Donkin's Harmonograph. The following is a brief account of the two instruments :—

In Mr. Donkin's machine, one rectilineal motion is imparted to the pen, whilst a second rectilineal motion is imparted to the revolving drum, carrying the paper on which the curves are described. In the modified form exhibited, a motion compounded of two rectilineal motions is imparted to the pen by means of two diminutive cranks and a beam, whilst the drum simply revolves, carrying the paper for the pen to mark.

Curves drawn by this machine were passed round.

Papers: C. H. M. Kerr (M) read a note on '*Edible Birds' Nests*,' exhibiting specimens.

The Report of the Ornithological Section, describing the condition of the egg cabinet, and appealing for contributions, by G. A. Solly (M).

C. Bayley (M) read the Report of the Aquarium, stating that it was in a much better condition.

MEETING HELD JUNE 17. (88 present.)

Exhibitions: Ancient British dagger found in Lawford Lane, by M. H. Bloxam (H). Death Watch, by M. J. Michael (M).

Donation: 'The Fallacies of Darwinism,' presented by Rev. T. A. Preston, of Marlborough.

Paper: The following paper on '*Optical Phenomena*' was then read by H. F. Newall (M).

'In a paper read a short time ago before the Society, on "Impressions," I touched upon the impressions of colours on the eyes. To-night I should like to say a few more words on that point, and also upon optical phenomena generally.

'The simple law of these impressions seems to be that the image impressed on the eye is of the complementary colour of the actual figure whence the impression comes. For example, look at a star of red colour for a few moments: then look at some plain

surface, and you will see the star of a green colour. Such an explanation of this phenomenon as the following suggests itself: suppose pure undivided light, or such light shining on a white surface, to move the retina of the eye to a high degree. The inclination of the retina, we may imagine, is to be moved sufficiently strongly to give us the perception of pure light. But now let us, on the background of pure undivided light, set a spot of red; and all the retina is moving to a high degree, except the little spot which receives the image of the red spot, and which is moving only sufficiently strongly to give us perception of red light. Now remove the red spot, and the spot on the retina is moving too slowly for the perception of pure light, and hence it begins to move more quickly. The difference between the rates of the two motions is that rate which, if we started at zero, would give us perception of green light. Or in other words, assuming that the inclination of the retina is to move sufficiently strongly to give us the perception of pure light, if we have it moving strongly enough to perceive red light, and then shew it pure light, it will shew us all the other components of pure light for a moment, until we have all the so-called coloured lights combined to form pure light.

'Now red, yellow, and blue are the primary lights. Hence, if we see red light, and suddenly turn to pure light, we shall see for a moment the other two lights blended, *i.e.* yellow and blue, or in a word, green. If we look at purple, *i.e.* blue and red, we see for a moment the one part which is wanting to form pure light, namely, yellow.

'We often get these impressions very easily produced, when the body is suddenly and unexpectedly strained. For instance, in playing racquets the other day, and endeavouring to hit up a ball, I slipped, and over the floor I saw a narrow green line. This I immediately recognised as the impression of the serving line on the front wall. In this case, though, I suppose I had scarcely looked at the actual red line for more than an instant, still the impression was strong enough to produce a green image on the floor.

'To the principles of impressions are due the results of the toy called the zoetrope, or wheel of life, which I should think most of you have seen. I have got the same results in a very simple manner. In the two big coloured windows in the chapel, opposite the pulpit, the two figures at the top of the centre part of each, are, in the upper part of the body at least, similar in all respects except as regards the position of the hands and arms. Now by looking at one, we get the impression of it fixed on our eyes, and looking at the other one, we carry the impression over to it; but it is almost immediately replaced by the actual figure of the second one; and as the position of the arms is different, we seem to see those of the impression of the first figure move to the position of the arms of the second, as if endowed with life. But now we have the impression of the second figure fixed on our eyes,

and this we carry over to the actual figure of the first, and again we have the apparent movement of the arms.

'Now let us pass on to other optical phenomena.

'I fancy I must have greater control over my eyes than most people; for I have compared notes, so to speak, with many other people, and find that I have far greater power to focus my eyes to an imaginary spot in space; I can hold my eyes in any focus without having to have a definite object to fix them on. For instance, holding a piece of paper in front of me, I can focus my eyes either for an imaginary thing between the paper and myself, or on the other side of the paper, always getting in the latter case a double image of the paper. But with the near focus I can if I like get a double image by focussing both eyes to one point in space, and I can also get a single image quite out of focus. This I can do from a power to focus each eye on points at equal distances from each eye. Moreover, I think my eyes are not perfectly achromatic, for often in looking at an object, I see the upper edges of it yellow and the lower edges blue.

'Taking advantage of this power to focus my eyes where I will, irrespective of anything to focus them on, I have noticed some curious facts.

'I drew a straight line in black on a piece of white paper. Now focussing my eyes between myself and the paper, I see one, or, if I like, two indistinct lines with prismatic colours in them, blue in the inside, with yellow on either side of it. Now focussing my eyes on the other side of the paper, again I see two indistinct lines, coloured, but this time the yellow is in the middle and the blue outside.

'I drew a straight line in white on a black background; and with the near focus, I got the lines with the yellow in the inside and blue outside, the reverse of what I got with the black line with the same focus. And with the far focus, the yellow was outside, blue inside, again the reverse of what I got with the black line.

'With coloured lines instead of a black line, I got practically the same results, *i.e.* with the near focus yellow outside and blue inside, or rather the combination of yellow and the colour of the line on the outside; and that of blue with the colour on the outside. For example, take a red line. With the near focus, I get orange on the outside and purple inside, and the opposite with the far focus.

'I painted one-half of a piece of paper black. In whatever position I held it, I always saw with the near focus the blue on the black, and the yellow on the white part of the paper.

'With simply a black dot on white paper, I get the same result as regards colouration.

'With a ring of black on a white background, with a certain focus very near, I sometimes get the white dot entirely filled up, and then either a deep orange or a black dot appears in the midst of a hazy blue dot, the same size as the actual ring.

'Another peculiar phenomenon is the following:—I had a piece of wood, with a hole $\frac{2}{16}$ of an inch in diameter in it, in my hand, and held it up to the light; looking through the hole with a certain focus, I got a curious dark spot in the middle of the hole. The same effect may be got by painting a white spot on a black ground: the dark spot in the middle seems to be attributable to the difference of the colour of the white, and the colouration due to the unfocussed state of the eye. Still this seems hardly to explain the phenomenon. For we should expect a light spot, since white is lighter than blue or yellow.

'I stood before a horizontal line, and focussed my eyes for a point between myself and the line, so getting a double image of any vertical line that was there, and a lengthened image of the horizontal line. If I moved my head on one side, so as to get the line of my eyes inclined to the line of the horizon, I got a double image of the horizontal line, and the double lines so formed were not parallel; for when I moved my head so as to get the lines very near together, sometimes they actually crossed, intersecting one another.

'Of such phenomena one could give hundreds of examples, if one only had the time to describe them. Even of the instance I have given, I describe only the general appearance, and do not give the changes which take place in the various focusses: and there are many such changes. I daresay I could see them more easily simply from the imperfection which my eyes have in not being achromatic; whilst others whose eyes are more perfect might altogether *fail to see* them.

'Light travels at a rate of 188,000 miles per second. Let us for a moment consider the very curious case which would arise if we could get a luminous body to travel more quickly than light. Let us, for the sake of ease in demonstration, suppose we have a body which travels at a rate of 6 miles per second, whilst light we will imagine to travel at the rate of only 1 mile per second. Now looking at the figure,* we will conceive the luminous body to travel from A to B, a distance of 12 miles. We will conceive ourselves to be stationed at O, 1 mile from the centre of the path of the luminous projectile. At zero of time, let us conceive the projectile starts, at the same instant becoming luminous. In one second it has reached H, for A to H is 6 miles. Still we see no light anywhere, for light travels, we suppose, only at 1 mile per second. In two seconds the projectile has gone to B. Now we see light for the first time, and that at H, for the luminous body was there a second ago, and light takes one second to travel from H to O, for they are 1 mile apart: and so in three seconds we shall see light at F, in four seconds at E, and in six seconds approximately at A, for a ray started from there six seconds ago, and A is nearly 6 miles from O. Hence it would take six seconds for the

* See plate 9, fig. 2.

ray to reach o. Now as the light is continually being radiated, we shall see a spot of light travelling from H to A.

'Now consider the other part, *i.e.* H to B. In a little more than a second after starting, the projectile gets to G and I and K; in three seconds after starting, we shall see light at G, for G is 2 miles from o, and the projectile was there two seconds ago. In four seconds we see light at I, and so on. And again, as the light is continually being radiated, we shall see a spot of light travelling from H to B, and that at the same time as the spot from H to A. Therefore what we see is this: a spot of light appears at H, which immediately splits, sending one ball of fire towards A, where it is instantly extinguished, and another towards B, which continues as far as the projectile goes.

'Again, if the body is luminous before it begins to move, we shall have a still more curious result. For we shall see light at A, and then suddenly a spot of light springs up at H, splits, and sends one ball of fire to the light at A, which light is extinguished the moment it reaches it, and another ball goes out in the same direction as the moving body. For ease in demonstration, I have only given a rough approximation to the distances at which we should see the light at certain times. For it is evident that we should see light at C sooner than five seconds.

'This simple case shows us how puzzling and awkward it would have been if nature had not made light, and consequently our powers of perceiving objects, so quick. If a body were coming straight towards us, we should not be able to avoid it, for it would have hit us before we saw it coming at all. And if the body was just passing us, we should not be able even to tell in what direction it was going, for we should have two images going in exactly opposite directions, and much less should we be able to catch the object, however much we might want it.

'With the case I have given as a formula, so to speak, we can work out some most amusing and ridiculous problems. I am indebted to a friend, Mr. Henry Holiday, for the formula, as also for a great deal of amusement in thinking of cases which would arise if we were suddenly to find ourselves transported to a world where such a state of things existed.'

Mr. Bloxam gave an account of some curious old papers relating to the School, which he had in his possession. One of them stated that the school finances were so far reduced some years ago that one of the masters only received 2s. 10d.

MEETING HELD JULY 1. (64 present.)

The President read a letter from R. H. Bolton (C), confirming the statement that spiders eat their webs.

Exhibition: Drosera Rotundifolia (Insectivorous Plant), by H. F. Newall (M).

Donations : Symons' Rainfall for 1875 : fossil jaw of Ichthyosaurus, by the Rev. A. Bloxam.

Papers : M. J. Michael (M) read the following paper on '*Ants.*'

'The other day, when out for a walk, I found a large colony of black ants (I pass round some for inspection) established in a willow, and as we have lately heard several communications read on this subject, I determined to make a few experiments myself, and report the results to the Society, if anything worthy of note occurred.

'Although the following experiments are not very original, yet it is always well to have a mass of evidence, as it more surely secures a right conclusion on the various points observed.

'I first tried putting a small heap of sugar about an inch from the line of march. Only a few came to it, stopped a few seconds and apparently eat a little, and then went away; but did not conduct any of their brethren to it. However, thinking that perhaps these were like the famous greedy schoolboy of the story, who kept his cake from everybody, and only looked at it himself, until, when he did cut it he found the whole inside eaten out by a mouse, I left it there for five minutes ; but as the same thing went on, I was forced to conclude this was a whole school of greedy boys turned into ants for their greediness. I then took it away, and no doubt the greedy ones came back, thinking to have it all to themselves, and felt as the greedy boy did.

'I then tried putting a heap of damp sugar directly in the line of march. This had still less effect, for some time at least; for they ran over it, and only one or two stopped to taste it, but at length a few stopped on the top, and were evidently eating some ; but this caused an obstruction in the path, so one irascible old worker seized one of the banquetters by the leg with its mandibles, and held on; then another coming up and thinking that some large thing was being pulled up into the nest, caught hold of the cross old fellow, and then another and another did likewise, until there was a string of five or six pulling with all their might; but the original cause of the disturbance not liking to be thus pulled away, held on with all his might to the sugar, till, when the string of ants had become somewhat long, and the motive force proportionately great, the sugar gave way, and the whole line fell to the bottom of the tree, where I afterwards noticed those that survived fought furiously, no doubt because they thought they had been unjustly treated.

'The third thing I tried was to paint a line an inch broad across the track, first with water and then with HCl. ; but neither of these had the least effect in stopping the march, far less indeed than simply drawing my finger across the bark.

'I then cut out a groove about half-an-inch broad across the roadway. This was productive of great results ; for all coming up

the tree were stopped, and did not know what to make of it, but those coming down one and all fell over the cut to the bottom of the tree; and so there was quite a continuous cascade of black ants for the first few seconds, but then some took caution, and stopped and walked up and down the groove, to try and find a way across, until the crowd of ants all stopped became considerable, and the waterfall began again, for the crowd behind gradually edged the front ones over the declivity, who finally came to rest at the bottom of the tree. So for some moments there was great confusion, and no doubt in their own language, "those behind cried forward, while those before cried back," until two or three coming up from below explained to the others how to go down, and at length the regular stream of ants continued their journey; but all those coming up halted for a moment, and were partially puzzled by it, while occasionally one or two unwary workers coming from above fell over. I noticed that those who were carrying anything did not seem at all confused by the cut, so wholly was their attention occupied by what they were carrying. For instance, I particularly watched two who were bringing up a dead caterpillar. They were very stupid, and did not work together at all, for at one time they would pull with all their might in different directions; then one would pull his end right up above the other one, and so the lower one, having to bear all the weight, would go slipping down the tree, pulling the top one after him, until stopped by a flat piece of bark, and since they worked in this way, their progress was proportionately small; but when they came to the cut they were going pretty fairly, and they did not seem to notice it at all, any more than if it was a smooth bit of bark.

'I then went to one of the red ants' (some of which I pass round) nests in the adjacent field, and having dug up a piece, captured some of the inhabitants, and tried to see if the black ants recognised that they were intruders when put in their line of march. At first they did not, but after a time, the red ones getting cross that they could not find the nest, seized one of the workers by the leg; then that one, at least, found out that there *was* something wrong, and retaliated by seizing this enemy by the body, and being the stronger, dragged him up into the nest, and I saw him no more. I was sorry for the red one, but no doubt it was a lesson to him not to be spiteful. I noticed that it was always the red ants who were the first to attack, and not unfrequently they succeeded in pulling a leg off their black enemies, which they clung to and carried about ever after as a trophy. I then tried putting some of the black ants into the red ones' nests; then they were very unmercifully treated; for five or six red ones attacked them at once, and held on to all parts of their body, no doubt causing them some pain. (I may here remark that all my experiments which caused anything but pleasure to the ants were done in the cause of science, and it was for this reason I would not allow a friend who was with me to put some of each kind in a pill box, to see if they would fight better if stirred up.)

'These were my experiments, and the conclusion, I think, to be drawn is, that if the ants have eyes, they do not use them, but rather trust to their antennæ, and so they tumbled over the piece I cut out of the tree.

'Again, they have very imperfect intelligence, or else they would arrange a system of carrying caterpillars up their tree.

'Again, that they are greedy, and the red ones, at least, very passionate, I think is obvious.

'I shall be very happy to tell anyone where the nest is, if he will undertake to settle whether they really do *do* anything, or whether, as some one suggested, they only run to and fro to hear the latest resolutions of the anti-vivisection society, and to get hot and fussy, in order that they may have some reason for biting each other's legs.'

M. H. Bloxam (H) made some remarks upon a Roman strigil found in Gloucestershire.

MEETING HELD JULY 15. (93 present.)

Exhibitions: Samian ware from Cave's Inn (on the Watling Street), by C. Kerr (M). Insects captured on the Society's expedition, June 8, by the President.

Donations: M. H. Bloxam (H) presented Potter's 'Antiquities of Charnwood Forest.' Belisneria Spiralis, for the Aquarium, by C. L. Rothera (C).

Papers: G. A. Solly (M) read a short account of the Society's Entomological expedition. The thanks of the Society were given to H. T. Gillson, Esq. (H), for his great kindness. This is the third year that Mr. Gillson has undertaken to provide the members of the Society with this enjoyment.

H. F. Wilson (M) read the following note on '*The uses of a Foreign Collection of Lepidoptera.*' [See plate 4, drawn by the writer.]

'The object of this short note is merely to act as a preface to some investigations into foreign lepidoptera, which I hope to be able to make next term, with the assistance of the President of the Society. The subject is a very large one, as the species are difficult to identify, and there are endless varieties. Indeed it is the varieties, and the gradations, which are exceedingly subtle, from one genus to another, which will form the main object of our search. The researches of Mr. Darwin and others have opened a large field for enquiry, and it is open to all to make new dis-

coveries, which will certainly be suggested when the matter is looked at by an entirely new light.

'It is a well-known fact that the butterflies of our island are in a painfully small minority; being only about 65 in number. Of course, on this account many species are wanting, and several large genera even are quite unrepresented. I do not know enough about the Asiatic insects to speak positively, but there must be very large gaps in our entomology, which are puzzling if we have no large foreign collection to refer to. The school has had some valuable presents of foreign butterflies from time to time, and is at last going to arrange them in a cabinet. The English ones will be inserted in their due order; and so a great opportunity will be given to study butterflies as a whole. I have made a selection of a few, English and foreign together, to shew what a complex, and at the same time what a deeply interesting study this will be. The butterflies in this box are from one of the earlier families, the Papilionidæ or butterflies proper. The genera are Gonepteryx, Anthocaris, and Pieris. My object is to shew how, when we get several species together, they seem to merge into one another, and have many common characteristics.

'Take the common sulphur butterfly, Gonepteryx Rhamni (Plate 4, *a*): in the South of France, there is a species Cleopatra, with a strong orange marking (Plate 4, *a'*), which has been bred by Boisduval *from the eggs of Rhamni.* Cleopatra, then, is in the first stage of variation, and in certain climates may now be considered a distinct species. Bearing in mind the general idea of a Gonepteryx, *i.e.* its angular wings, and leafy appearance underneath, we turn to the butterfly below (Plate 4, *b*), whose name I do not know, and observe the same characteristics, combined with orange and black markings that point decisively to the genus Colias, or Clouded Yellows.

'Now observe the series *b*, *c*, *d*: the leaf-like appearance which we noticed in *b* is less in *c*, and nearly absent in *d*: while the slight orange markings of *b* have developed into the more pronounced orange of *c* and *d*. On the other hand, the series *b'*, *c'*, *d'* shews a gradual approximation from the leaf-like appearance of *b* to the simpler colours and rounded shape of *d'*. Also notice that in the series *b'*, *c'*, *d'* there is no orange; and the yellow gradually disappears. Again, there is a connexion between the ends of the two series in the fact that the female of *d* (viz. Cardamines) has no orange at all, and on the upper surface is very like *d'*, or Pieris Brassicae. This short introduction is necessarily very imperfect, but I hope before next term is over to have contributed a good many interesting facts to the Society.'

H. L. Stephen (A) read the following paper on '*Bird Keeping.*'

'I have in the last two years kept many birds (their name being legion), and I think I may flatter myself that I have, all things being considered, been fairly successful. A great point in favour of maintaining birds rather than other animals as pets, is, I think,

the ease with which they are procured, and the comparatively small amount of trouble which it is necessary to bestow on them.

'My first birds were two redpolls, bought from a wandering tramp. I bought these birds much against the advice of my friends, who, with that kind attention which is so common to many, all assured me that my birds would die in a few days. Die, however, they did not, but lived and flourished. The most curious characteristic of these birds was the effect the sunlight had on them. I kept them in a window looking south, where they received the full benefit of the morning sun. Then they were gay and lively. Gradually circumstances over which, alas, I had no control, shut out the sunlight bit by bit; as their daily portion of sunlight decreased, their spirits grew lower, till at last, when the window looked out on to a dark and sombre passage, they remained all day on their perch, and refused to be comforted. At last a snowdrift which playfully located itself in my study one night, put an end to one of the melancholy prisoners. The other dragged on a weary existence till, with the return of spring and the advent of two canaries, he was liberated. These canaries led a somewhat dreary existence at the darkest end of a dark study. The only event which ruffled the otherwise even flow of their lives was an occasional fall, cage and all, on to the floor. On these occasions, though the cage was invariably almost mortally injured, the birds remained unharmed.

'One of these birds, I believe, yet lives. I had left him in charge of a person (let him remain satisfied with that appellation) for a space of two weeks. At the end of that time, when I enquired after the safety of my feathered flock, I was informed that the cock (the best of the two) had got out from between the bars, and had fallen a victim to the cat. Occasionally I hear a sound issuing from the regions whence comes my dinner, as of a canary singing. I sometimes look through an open door and see —no matter what—and think—well! something! After this, I purchased many canaries, who came to divers ends, one through a cat, one through causes unknown, one through the pressure of a large box on its body; but finally I procured a fine German canary. He was the best songster it has ever been my fortune to possess. He sang almost without stopping from morning to evening; he sang while travelling in a train, in a dark cage covered with brown paper. He gradually became tame, and at last was able to perform some of those tricks of which showmen so boast at a children's evening party. The fate of this bird was perhaps less melancholy than that of his predecessors. The bottom of his cage came out, and he fled to return no more.

'Since then I have trained two redpolls to a high state of cultivation. Of all birds I think a redpoll is the most tameable; he learns quickly, but he soon forgets his cunning. A friend presented me with a pair of bullfinches. One of them, a fine cock, died of starvation. His seed-glass got turned in such a way that

the aperture in the glass was not opposite to the aperture in the cage. The bird was driven to devouring the sand at the bottom of his cage, and he died; his widow lives yet.

'I live in London, and I would caution all my friends against buying any British birds at any West-end emporium. Canaries and foreign birds cost much the same all over the country, but the dealers must make a fortune out of bullfinches, goldfinches, &c., judging from the exorbitant price they demand for them. The best way to procure ordinary birds is to catch them yourself, or to get a friend to do so.

'In the matter of keeping birds, imitate nature as much as possible, and don't "coddle" your birds. Don't be afraid that they will be too hot, or too cold. Birds always thrive better if kept in a sunny place. I have never yet known a bird which did not prefer hemp to canary-seed. I should advise keepers of birds to mix hemp and canary-seed in equal proportions, and to refuse to give the bird more hemp till he has partaken of the canary-seed.'

Mr. Bloxam read a very interesting paper on the '*Dun Cow*,' which we hope some day to give to our readers. (See Plate 9, Fig. 1).

MEETING HELD OCTOBER 14. (90 present.)

Exhibitions: Botanical Register (price 9d.), by H. W. Trott (C). Entomological Collection made in the Holidays, by C. Bayley (M). Two cases of Lord Dormer's beetles, by the President. First drawer of the new foreign Lepidoptera, by the President. Erinus Alpinus, a rare plant from Tintagel, by M. H. Bloxam (H). A volume of the Society's Botanical Collection; also specimens of Seeds; by Mr. Cumming.

Mr. Hutchinson then made some experiments to shew the increase in power of an electro-magnet caused by surrounding it with a cylinder of soft iron.

The President announced that G. A. Solly (M) had presented 40 kinds of eggs to the School collection (for particulars see Zoological Report). He also announced the Society's Essay Prizes, as follows:—

1. ———
2. H. G. Hitchcock (on '*Dogs*.')

Extra Prize. H. L. Stephen (on '*Ghosts*.')

Papers: The President then read a paper on Sectional work, the substance of which is embodied in the Sectional Reports.

Mr. Cumming made some remarks to the Botanical Section, especially drawing attention to the usefulness of making sketches.

The President then read the following note on '*Cannibal Caterpillars*.'

'Several caterpillars are known cannibals: is it recorded that the common Spilosoma Lubricipeda is one?

'Early in October this year I had several in a cage together. Owing to various distractions I neglected for a day or two to replace their food when dry. I was surprised to find on opening the box, that one of these hungry ermines had actually opened a cocoon of another, dragged out the chrysalis, and devoured about half.

'While I am on this subject I should like to record that a few years ago I had some Polia Chi larvae which feed on nettle: and they, likewise, being short of provisions one day, positively attacked some pupae of the Tortoiseshell, which were hanging helpless from the roof of the cage after their manner, gnawed through their skins and sucked them dry. It is to be observed that the Tortoiseshell also feeds on nettle.

'The Ermine larvae could scarcely eat each other, as some cannibal caterpillars do: they are too hairy: it would be like eating mutton raw, and beginning with the fleece. But a chrysalis is equally juicy, far more helpless, and quite naked.'

Mr. Bloxam remarked upon the plant from Tintagel, introduced from France as a rock plant in 1739.

MEETING HELD OCTOBER 28. (100 present.)

The President read a letter from M. J. Michael (C) containing some notes (see Entomological Report). He also announced that the Society had entered into relations with Watford and Northampton.

Exhibitions: Botanical drawings; sketch of D. Lineata and Euphorbiæ (larvæ); and white blackberries from Rugby; by Mr. Cumming. Glaciated Block from Brownsover, and other specimens, by Mr. Boughton Leigh. Coprolites, etc., by Mr. Wilson. Ichthyosaurus teeth, by H. Oldham (A). Mica Schist from Rugby, by Mr. Wratislaw.

Donation: Cuvier's Animal Kingdom, with engravings, by Rev. A. Bloxam.

Papers: The President read the following paper on '*Cats*' by an anonymous contributor.

'Topsy was a kitten when we first had her. She was quite black, and came of a good family. She received her education at the hands of my mother, who was at that time confined to her bed through an accident, and Topsy sat on her bed the greater part of the day, thinking, no doubt, she was doing her duty in keeping her mistress company. She took her meals here also, and thus was brought up in the way she should go.

'Topsy was a model of propriety. Having been brought up from infancy in polite society, far removed from the atmosphere of the kitchen, she possessed those manners that every well-bred cat should have. She would sit on the corner of the tea-table close to the milk jug, and express her satisfaction audibly at the near proximity of her favourite beverage, but never, by word or deed, would she ask for any—she waited until it was given her.

'Topsy had a kitten—Tommy—also black, except a few white hairs on his chest. Tommy became the object of my earnest solicitude from a very early age. His education was conducted upon the most approved principles. "Spare the rod and spoil the child" is as applicable to kittens as children, but Tommy required but little chastisement; he had a lively fear of a whip, the mere sight of which was sufficient punishment. His mother, on the other hand, did not care a bit, and if you gave her a smack would not budge an inch, but look at you and express her feelings in language that was far from complimentary, although at other times she was a most polite cat, but then her dignity was upset, and she took care to let you know it.

'When the kittens were naughty, and yet too small for corporal punishment, we had resource to an expedient that I flatter myself is rather original—*we beat the mother*—she, smarting under the opprobrium thus cast upon her, retaliated upon her offspring, who thus received their punishment in the manner most calculated to impress itself upon their youthful minds, especially as it was accompanied by plentiful abjurations in the feline tongue.

'Tommy grew up into a fine cat. *Such* a tail he had! *such fur!* His tail, when distended by the sight of a strange dog, measured about 4 inches in diameter. It was quite 14 inches long. He was the pride of his mother's heart—her first-born. She used to wash his face for him carefully, for I am sorry to say that Tommy was a lazy cat—his morning ablutions were veritable "cat-licks." He was too lazy to catch mice, which he left to the tender mercies of his mother, but with *birds!* ah! there the case was different.

'One day I saw Master Tommy make his appearance from the garden carrying a large blackbird, and uttering in a smothered voice, "Ma, ma." His "ma" came, whereupon he presented her with the bird and trotted off. Now was not Tommy a dutiful son?

There were now two corner ornaments for the tea-table—Topsy on the right hand, Tommy on the left. They were very fond of bread, which they eat in the most genteel manner, by taking it up in the paw, and placing it in the mouth. I am bound to say, however, that this mode of procedure was necessitated by the circumstances, for I put the pieces of bread underneath the edge of the tea-tray, whence they could only be obtained by clawing them out. Tommy used often to sit upon my shoulder at dinner. He would spring up there from the floor, and if a visitor occupied my place at table, he ran the risk of being more startled than pleased by Tommy mistaking him for me. I shall never forget the horror of an old gentleman who was subjected to Tommy's demonstration of affection. Poor Tommy was ignominiously thrust out of the room, and this made such an impression on him, that ever after he was careful to look before he leapt, and would even ask permission by a "Mow?" "Mow," replied I; he was up in a moment.

'Can cats be taught not to steal? I think not. However apathetic they may appear to the outward eye when people are about, just leave them alone with some succulent morsel in the way of a chicken or partridge, and then see! There was one thing, however, that Topsy would help herself to in the most barefaced manner, and that was biscuits. No sooner did she hear the rattle of the tin, than she was upon the table in a moment, and if not offered one, would proceed to help herself; she looked upon biscuits as one of her perquisites.

'One day Tommy was missing. Dinner came—no Tommy took his wonted place upon my left shoulder; tea time came—Tommy's corner was vacant, and Topsy came in foı an extra quantity of milk; bed time came—still no Tommy. But let me draw a veil over the sorrow that agitated our breasts—Tommy *never* returned. Of what became of him who shall say? Was he cruelly murdered for the sake of his lovely coat? did he fall an untimely victim to a rapacious dog? Strange sounds were heard in the recesses of the roof; we searched, but our search was barren—no Tommy—no "*nothing*."

'Of Topsy's other kittens I do not know much, but one fact deserves mention. Topsy had a mortal enmity for dogs, especially bull terriers, but of those of her kittens who were brought up in the companionship of a white dog of this species, one or two exhibited a great fondness for him, so that the opinion expressed by a recent writer to *Nature*, that some kittens who had been nursed by a dog must have inherited their mother's fondness for the canine race, does not hold good. What is more natural than that the children should be attached to their foster-mother?

'These cats were very good hands at opening doors. If not latched, a vigorous "claw" did the business; if that failed, they would stand on their hind legs and rattle the handle to attract attention of people the other side.

'If called by name they would *answer*, and come running to know what was wanted, and they would follow my mother all over the garden, like dogs.

'Topsy is now no more. She died last spring in a ripe old age, having shown, by her life, that cats are capable of attaining to the manners and customs of polite society; by her affectionate disposition, that they possess the power of appreciating and returning kind treatment; and by her numerous little ways, that there is a power of reasoning and observation in the mind of a cat, that under proper cultivation might equal, if not surpass, that of the most intelligent dog.'

The President read the following paper on the '*Larvae of Mamestra Persicariae*.'

'Last year I bred some thirty or so of this moth, and not requiring them for the school cabinet, I was seized with a fit of humanity (generally supposed to be alien to the spirit of a collector), and dismissed most of them in the June sunshine into my back garden. Apparently, having got their liberty unexpectedly, they resolved to take it out of my flowers and vegetables: or else they wished to shew their gratitude by giving me a fine stock of caterpillars this year on which to make experiments. Anyhow, when I returned after the holidays, I found the place swarming with them. I have not got nearly all there are, still less all there were. Many are doubtless always killed by cold and rain: some die of disease when changing their skin; some overeat themselves, and die of a kind of cholera; some fall a victim to birds and ichneumons; still more, of course, escape the notice of the most searching entomological eye. But even so I have got about a hundred. And I have made one observation which perhaps may interest the Society.

'Anybody who has collected the Mamestra larvae will have observed a tendency in them to vary between brown and green. The common cabbage moth is both brown and green, besides intermediate colours. The Persicariae has the same peculiarity. The brown variety looks so different from the green, that young collectors, who do not observe that the markings are peculiar, and always the same, fancy they have found two distinct species. The majority of them are distinctly one or the other: till this year I thought they were all so, and conjectured it possibly might be due to a difference of sex. But this year I have found so many intermediates, some mostly green with faint brown inclination, some mostly brown with rich greenish tints, that that suggestion is no longer tenable. Among moths, at any rate, there are no such things as effeminate males or masculine females. There does occur, of course, the *lusus naturae* called Hermaphrodite, where the sexes are combined; but that is so rare as to be out of the question here. What is it then?

'This year, however, I noticed another peculiarity. Nearly all the green ones I found were on the scarlet geranium. I should mention, by the way, that Persicariae is a most omnivorous beast. I have found him on violet, ivy, lavender, geranium, pear, apple, barberry, and other plants. In most of these he can easily get concealed; in geranium, owing to the shape and growth of plant, he cannot hide so easily. Well, it is singular that nearly all the green ones are on geranium, *where it is of use to them to be green.* They are occasionally green or intermediate on the other plants, but not by any means in so large a proportion. Is it possible that the colour is protective? We must be careful to avoid falling into a confusion of ideas here: it is not a case of what is ordinarily called protective colour. The theory of protective colour, as detailed by Mr. Wallace and Mr. Darwin, is that among the variations of colour those have a tendency to survive which are most use; that so the proportion is gradually increased through succeeding generations till the protective colour is the normal one of that species. This cannot be the case with Persicariae; for he would have to have inherited, not a tendency to be green, but a tendency to be green when he is on scarlet geranium; which is too complex and subtle a quality for us to venture to believe inheritable. We must reject the notion that the colour is protective by natural selection.

'Other possible explanations of the facts occur to me, which I throw out as the merest conjectures, in the hope that other people may be interested to make observations bearing on the point.

'(1) It is possible, of course, that it is *accidental.* 100 caterpillars is a small number of the whole: I have not noticed it (nor the contrary of it) other years: and there are brown exceptions on the geranium, and green exceptions elsewhere. On the other hand it may be replied, that where the caterpillar is hidden, *i.e.* on other plants, his colour would not matter, and natural variations would have full play: while on geranium the proportion of green ones is so large as to suggest at least that it is not due to pure chance. Experiments and observations would throw light on this.

'(2) It is possible that the *food* plant may influence the colour. The food certainly does not determine what colour a caterpillar shall be: but given a regular variation between two or more colours, the food may decide which of the colours open to the beast (so to speak) shall prevail. Colour must be due, one would think, to conditions continued through generations—at least partially: and food is the principal condition of a caterpillar.

'(3) It is possible that the *light* may have something to do with it. On the other plants, Persicariae has far less light. He feeds mainly by night, and hides by day. Only on geranium, even when hidden, owing to the nature of the plant, he gets far more light than elsewhere. Plants which grow in the dark are, I believe, known to change colour. Perhaps some botanist will throw light (excuse the play on the word) upon this subject.

'(4) It is possible that the beast roams about a good deal from plant to plant, and having some kind of instinct that he is safe on his own colour, the green ones mainly venture on the exposed geranium. Some support is given to this theory by the very voracity and omnivorousness of Persicariae. It is safe for him to wander about, for he is sure as far as supplies go to fall on his legs anywhere. I believe he would eat a piece of paper if you painted it green and gave it to him damp. One very curious observation I made bears on this point. The green larvae I picked off geranium were anywhere—on the leaf or down the stalk: usually a little out of sight, but sometimes right on the top of the leaf, and even then, owing to their colour, hard to see. But whenever I found a brown larva on the geranium—a rare exception, as I have said—he was always sheltering on a decayed leaf, which was itself brown. This time of the year there are sure to be such leaves on the geranium, with enough tenacity to bear a caterpillar's weight, and, from their colour, an admirable shelter from the enemy. I believe the only time I found a brown larva on a geranium leaf, that is, not protected, he was eating. Poor brute, he couldn't help himself, for of course he couldn't eat the brown leaf: it would not have been nutritious. He should have kept the caterpillar's Ramadan, and eaten only after sunset: his gluttony ruined him.

'Anyhow, I think my observations go far to incline one to believe one thing: that the caterpillars instinctively take shelter on their own colour. And that is a fact of some interest, as bearing on instinct.

'In conclusion, there must be still hundreds of Persicariae in Rugby; and *every* observation will be of value, either as supporting or invalidating my provisional theory, and perhaps throwing light on the whole subject of colour.

'P.S.—Since writing the above, another explanation has been suggested to me: that the large number of green larvae on geranium may be due to the fact that the birds eat off the brown or unprotected ones. This may be the case to some extent: but the proportions of the numbers seem to be against its sufficiency to explain the whole phenomenon. I have not counted accurately, but roughly speaking I have found about thirty larvae on geranium, of which I should say twenty-five were green. On other plants, where they were hidden, I have found about seventy; and of those not more than about seven or so were green. Suppose then that this is about the normal proportion, it would give one-tenth green. In that case the birds would have eaten about 250 brown larvae off the geranium; an appalling total. My geraniums would have been eaten down to the ground.

'On the whole I don't think this explanation can account for the fact.'

Mr. Cumming remarked that Hadena Oleracea was known to change its colour with a change of food.

H. G. Hitchcock read his paper on '*Dogs*' [see page 52]. The following were the most interesting passages :—

'Well known as the dog is to all my hearers, I venture to make it the subject of my paper to-day. In Eastern Europe and Asia the dog has from time immemorial been looked upon as a creature only fitted to perform the office of scavenger: but in Western Europe, the happy home of local boards of health and patent hydraulic vans, he has long held his proper position as, after woman, the most suitable companion for man. But it is only since a comparatively late date that thorough and proper attention has been given to the pure breeding of dogs. It is to Mr. Shorthose, of Newcastle-on-Tyne, that we are indebted for holding the first dog show in England: and England having set a good example, as she did in those days, America was not slow to follow it. Of course, in some isolated cases, strict attention had before been paid to the breeding of some few kinds of dogs: the Lyme Hall strain of mastiffs has a pedigree which reaches as far back as 1415; but it was not till 1859 that the dog show at Newcastle created a competition which has done so much to preserve the various breeds unmixed. Unfortunately, dog shows are not managed as they should be: no fixed scale of points is adhered to, and consequently the latitude allowed to the judges is to the unprincipled among them (and their name is legion) a temptation to onesidedness which few can withstand.

'It is the way in this Society, I believe, to report from time to time the notable specimens to be found round Rugby. Now the well-bred dogs to be found in and near Rugby are not many. Mr. Fuller, of Bilton, has a splendid old English mastiff: you may often see "Sultan" in the High Street, a fine tawny fellow, with a splendid head, and legs like pillars.

'Mr. Edwards' little dog "Punch," a favourite, unless I am greatly mistaken, with most Rugbeians present, is evidently a very well-bred dog, and, if its nose was darker, might come off well at a show.

'Bulldogs are represented by a pair belonging to Mr. Bucknill, and by Mr. Collins' dog "Crib." About this class of dogs I should like to say a word or two. We all know the old proverb, "Give a dog a bad name, and hang him." Now in the case of bulldogs the British public are inclined to act as nearly up to this maxim as may be. This feeling is carried to such a pitch, that in many cases a poor man who keeps a bulldog finds himself looked upon as a suspicious character, and a blackguard. In some such cases, no doubt, there is reason for the accusation: but in most it is the fact of his keeping a bulldog that brands him a rascal. And why? Because people believe that bulldogs are by nature very bad-tempered, and so utterly lacking in all feelings of affection that they make very little distinction between the world in general and their own particular masters. No more mistaken idea than this

ever took a hold on men's minds. They are so far from being naturally bad-tempered, that they will refrain from revenging the attacks of small dogs, even though persisted in for several minutes, and so little do they lack affection that they will not hesitate to sacrifice their lives at their master's bidding, or in his defence. I do not want you to believe this without evidence; a writer to the *Animal World* tells the following tale: "Many years since, I was walking through Chapel Street, Edgeware Road, when I was attracted by the conduct of two dogs, the one a bulldog, the other a sort of mastiff, much larger, and evidently longing for a battle: he attacked the other, and tried to make him fight; but the bulldog, whose very countenance expressed good temper, after defending himself at first, walked quietly away. Determined to quarrel with somebody, the mastiff seized on a small terrier, who was passing, and laid him yelping on his back: in an instant the generous bulldog flew back to the rescue, and having rescued the little sufferer, refused to fight any more, and again walked away. The mastiff watched the retreating hero, and when he thought he was far enough off not to interfere, he attacked his poor little victim a second time; but his champion heard the cry, and again rushed to his aid. When once more freed from his persecutor, the bulldog this time did not leave him: the terrier rubbed his nose against his friend's, wagged his tail, and in some way whispered in his ear that he still needed his protection. They then walked away together, the bulldog evidently to see him safe home, as it was in a contrary direction to that which he had at first taken. The discomfited tyrant did not venture to attack him again, but stood looking subdued and sulky. Several persons, with myself, were spectators of this scene of canine generosity and ill-temper." But though the real nature of bulldogs is to be quiet, good-tempered, and affectionate, it is easy to see how they got their bad name. In the first place, the name bulldog suggests bull-baiting and its horrors: and so, just as bloodhounds got a bad name from their connection with blood, bulldogs got theirs from their connection with bulls. And secondly, it is easy to see how an animal endowed by nature with every facility for fighting, immense strength of limb and jaw, a loose skin, and an indomitable spirit, and who was only unchained from his kennel in order to engage in mortal combat with another animal, became so soured in temper that what was forced upon him as a habit became a second nature. But when bulldogs are treated as other dogs are, as the companions of men, they do not become fierce and intractable. There are exceptions, of course; but in all breeds of dogs you will find some whose temper is bad: and I may add that even among men instances of such natures are not scarce, and yet no one would think of denouncing all mankind as bad-tempered and unaffectionate.

'But the most noted dog near Rugby is in the possession of Mr. Cooper, of Hillmorton. His fox-terrier "Jock" has taken, in

his day, the first prizes at Nottingham and even Birmingham, not to mention hosts of minor shows, and as a stud dog he is far-famed. The groom who had the charge of him had a great love of filthy lucre, and consequently half the small dogs of the terrier class in the neighbourhood have Jock's blood in them. Among these, Mr. Cropper's "Nell" and Mr. Lindon's "Rose" are most conspicuous for their beautiful heads and tulip ears.'

Mr. Bloxam made some interesting remarks on Spurs, of which the following was the substance. The earliest were Roman, with a straight shank, 14th century. Norman were curved. The rowels came in with Edward III. Long-necked spurs (Henry VIII.) were found at Coventry. New spurs were given with the Garter, and the knight sent his old ones as a fee to the king's head cook. An account was also given of modern spurs from Mexico, Texas, and the Crimea. A few of these spurs are drawn by C. Kerr (M), on Plate 8.

MEETING HELD DECEMBER 2. (68 present.)

The following notice was read from the local papers:—

A RARE VISITOR.—On Saturday last, a son of Mr. M. West, farmer, of Braunston, was going into a wheat field for the purpose of driving off a flock of crows which had settled there, when he noticed a peculiar-looking bird amongst them, of a grey colour, and with awkward gait. The bird did not rise with the crows, so he fetched a gun and shot it. Upon examination it turned out to be a fine specimen of a kind of seagull, called a Kittywake. It is very unusual for these birds to be seen so far inland, but it is said that when stormy weather is forthcoming, gulls hang about the land and sometimes fly inward; the reason given for this is, that the fishes on which they feed keep deeper in the water at the prospect of stormy winds, and consequently the gulls are compelled to resort to the worms on the land for a dinner; and strange to say, that sort of weather makes the worms feel uncomfortable, and wriggle up out of the ground to be swallowed by the gulls.

H. W. Trott communicated a note about the rooks' nests in Mrs. Tunnard's garden: [see Zoological Report, and plate 7].

Exhibition: The Marlborough Report, by the President.

Donation: Foreign butterflies, from M. J. Michael (C).

Papers: Mr. Percy Smith read the following paper on '*Hardened Glass.*'

'Every mistress of a household knows, to her cost, that glass is a very perishable article in the hands of domestic servants. The usual excuse offered after some accident is, "Please mum, *it* broke."

'Now strange as it may seem, *it* does sometimes break apparently of its own accord, the usual cause being that the glass is badly annealed, and flies when immersed in warm water, or sometimes the breakage occurs when no one is touching it.

'There have lately been some letters in the *Times* about the manner in which hardened glass breaks. I therefore purpose to give you a short history of that article.

'According to Pliny, a man is said to have invented the making of flexible and malleable glass in the time of the Emperor Tiberius. The happy inventor, in hopes of a rich reward, presented to the Emperor a beautiful vase constructed of the new material. Contrary to his expectations, Tiberius broke into a violent passion, and dashed the vase upon the ground, as he thought it would depreciate the value of gold and silver. To the astonishment of the Emperor and his court, the vase was not broken, but their astonishment was increased by seeing the maker of the vase pull forth a hammer from his robe, and repair therewith a dent that had been caused by the fall. Tiberius asked him whether any besides himself possessed his secret, and when the incautious inventor answered "No," he ordered his instant death, that he should not have the chance of imparting it.

'For years people were lost in conjecture as to what this vase was made of; some thought it was aluminium; others, fused chloride of silver. None, however, were certain.

'In the year 1873, the invention was announced of a new glass that would resist the action of blows, and of fire. In the autumn of the same year, a company was formed at Bourg, in France, with a capital of 1,200,000 f., to work this new glass, the invention of a M. de la Bastie. It was thus prepared: ordinary glass was heated in a furnace till it reached a half molten state, and then plunged into a bath of oil or fat. The furnace was so constructed that the sheet of glass was slid or rolled into the oil-bath without coming in contact with the external air. The glass thus prepared possesses extraordinary hardness.

'The following experiments have been made. A sheet of ordinary plate glass ¼ in. thick, supported horizontally by a wooden frame, had dropped upon it from various heights a weight of 4½ oz. The glass was broken when the weight fell 31 in.

'When a sheet of hardened glass of *one-half* the thickness was substituted for the above, it bore the fall of the weight from a distance of nearly 6 feet without fracture. When it did break, however, it was shattered into a mass of minute fragments.

'A strip of ordinary glass placed in the flame of a lamp broke in 24 seconds, whereas a piece of hardened glass resisted the action of the flame until it had nearly attained a red heat: when the heated glass was dipped into cold water it was uninjured.

'The hardened glass has been examined with polarized light, which examination has confirmed the theory that the outer portions have been contracted, and that the inner portion is in a state of

considerable compression; consequently when the equilibrium is disturbed, the glass flies to pieces.

'M. de la Bastie's invention can hardly be looked upon in the light of a discovery, since a similar thing has long been known, under the name of "Rupert's drops," which take their name, I have no doubt, from Prince Rupert. They are made by pouring molten glass into cold water. The glass solidifies in pear-shaped drops, or tears, which are extremely hard. If, however, the tail of the drop be broken, the whole flies into a countless number of pieces. M. de la Bastie, however, uses oil instead of water; so his conditions are slightly different.

'A remarkable fact connected with hardened glass is, that it may be ground on a stone with sand, so long as you remove the surface *equally*; but on the least attempt to chip it, the whole flies to pieces. In the manufacture of ordinary glass articles, they are carefully annealed after making. They are put into a hot oven, the temperature of which is suffered slowly to decline, until it reaches the temperature of the air. If this is not done, the glass is liable to break at the slightest alteration of temperature, and even at a very trifling blow. Here is a flask which has not been annealed; and although it will bear enormous pressure *externally*, on account of its thickness, a fragment of flint dropped inside shatters it.

'Glass expands considerably when heated, but it is at the same time a bad conductor of heat; consequently the thicker the glass, the less able is it to withstand sudden alterations of temperature, because the part nearest the source of heat will expand before the adjacent portions have got hot. So all vessels intended to be heated should be of thin glass, in order that the heat may spread more rapidly.

'A week or two ago, Mrs. Nassau Senior wrote to the *Times* to the effect that a gas globe of hardened glass had, some time after the gas had been extinguished, fallen upon the floor, and continued to split up, bit by bit. This seems to contradict the statement that hardened glass is unaffected by heat But of course it is possible that the globe was not well prepared, or perhaps it was clamped too tightly in the holder. The splitting into fragments is nothing new.

'The tempering of glass was patented in England on August 12th, 1873.'

H. L. Stephen's essay on '*Ghosts*' was then read by the President.

The following paper by L. Leverson (A) was then read; the subject was '*Diamonds and Opals*.' It was accompanied by a few most beautiful gems as illustrations.

'The subjects of this note (for thus our worthy President promised to style it) are diamonds and opals. Everybody, I

presume, has seen a diamond, but it may be of some interest to know what they look like when rough, and to learn some particulars about the most renowned diamonds. A rough diamond is, or rather ought to be, octohedron in shape. The diamond has a peculiar lustre known as adamantine; it is generally colourless, transparent, and pure, but diamonds are sometimes, though rarely, found of a blue colour, which may be mistaken for sapphire; there are also rose, red, green, yellow, and violet diamonds. The most general, however, and the most valued colour, is white. Of these latter I have two specimens, of regular octohedron shape; also one yellow specimen with spherical planes, one brown diamond still more modified in shape, and lastly, a grey diamond. This latter is of no value as a stone, but its use is when ground into powder to polish other diamonds. These stones are in their rough state, and have to be cut before any use can be made of them. The most valuable stones are cut into a double-pyramidal shape, and are called brilliants. The rose, which has a flat under surface, is the next valuable, and the table diamond, with flat under and upper surfaces, is the least valued.

'Perhaps the finest and best cut diamond, unrivalled for shape and water, though by no means the largest, is the Regent; it now belongs to the French, and has been valued as high as £480,000. After the Regent comes the Koh-i-noor, that is to say, the Mountain of Light; it is the oldest known diamond. According to Hindu legend, it was found in South India, and was worn in battle by Karnah, king of Anga. This worthy gentleman is supposed to have lived 3001 years B.C. It is now in possession of the Queen, and is to be seen in the Tower. Besides these, I ought to mention the great Mogul diamond, which weighs 280 cts., and the Pole Star, a perfectly white brilliant of 40 cts.

'So much for the diamonds: now for the opal. I have here two rough specimens which I obtained during the last holidays, in the only opal mine which is still worked in Upper Hungary; there was a mine in the neighbourhood of Frankfort, but it is no longer worked. Opals were found in Hungary as far back as the Roman conquest, and the name is supposed to be derived from the words of the ancient shepherds, who on finding the stone said to each other, "O, pal," which in early Slav language is supposed to mean "Oh, look." The only authorities I have for that are the workmen who told me that story last holidays. There are two kinds of opals, and I have specimens here of each kind, which I got out of the mine. You will see that one is white and milky; this is what the miners call the 'spur' or scent, it is the index as it were of valuable opals, it is of no value by itself, but where it is found, the rock is blasted, and then the second kind is sometimes found, which is the precious opal. The value of the opal depends on the size of the stone, and the quantity of green shade or fire it possesses. The opal having all its fire in itself, needs no regular faces to refract the light. It therefore only is polished on stone or wooden wheels,

but needs no regular cutting, as the diamond. Opals have not been used very long for jewellery, and it is said that under the reign of Maria Theresa, they were sold at the market place of Kashan (that is the town nearest to the mine), by butchers and sellers of tripe. It was then used for charms, and was supposed to possess all kinds of miraculous properties.'

A note was read from R. H. Bolton (c), on '*Spiders*.'

The following paper on '*Practical Entomology Abroad*' was read by C. Bayley (M).

'I think, before rushing into my subject, it would be as well to give some sort of hint about the apparatus required for a trip abroad, with an eye to portability and strength. A folding net, with materials for repairing it, may be said to be indispensable. Pins, assorted sizes; a small setting-house, and a store box for preserving your specimens when set, and 8 small pocket boxes. Much care should be exercised in the choice of cork for your box, for on its tenacity depends the safety of your collection. A bottle of chloroform is useful for stupefying large moths when first caught, and a bottle of cyanide finishes them as well as anything. The time to catch them is, apparently, the butterflies from sunrise to sunset, and the moths from sunset to sunrise. I have never been out in decent weather without making some addition to my collection. The butterflies crowd in the fields, particularly the lucerne fields, of which there are generally plenty, and you may see a dozen species at once, many of which would be considered a rare capture in this part of the world! Camberwells and Swallow-tails flit in plenty over the grass, and need only good running powers, or extreme craft, to capture them. If once started, you have to be a *very* good runner to catch them up, as they scorn anything under 15 miles an hour, and can keep it up for an indefinite period. They can sometimes, however, be captured at rest without difficulty, but much caution is requisite in approaching them, to prevent their being alarmed. I on one occasion saw two Camberwells and a Purple Emperor perched on some sap that was oozing out of a crack in the bark of a birch tree, but though I got the Camberwells, the Emperor gave me the slip, and went over the tops of the trees at a rattling pace. This was the only occasion on which I saw his purple majesty at large. About 7.30 in the evening, the moths come out in enormous numbers, the commonest being the Convolvulus Hawk (S. Convolvuli), a specimen of which was *once* caught here, and is thought a great prize. I have seen twenty of them flitting over one bed, and have even caught them with my hands, as they hovered dipping their enormous tongues into the cups of the flowers. Their favourite flower is the petunia, and this is never without them after dark. In the day Humming-bird Hawks abound over the flowers, and I have frequently noticed them perching on the stones on a gravel

walk; what they were doing I can't think, as there was nothing to eat but pebbles, and I think they are outlandish food for such fragile creatures. The commonest and most widely distributed butterfly abroad is the Clouded Yellow (Edusa), which can be found everywhere in great profusion. The Pale Clouded (Hyale) is nearly as common as its cousin. The Fritillaries are numerous and various, but the large ones manage to tear themselves to such an extent that, though the fly be common, the perfect specimens are almost impossible to get. The scarce Queen of Spain is by no means rare, and I have often caught them. The Hair Streaks are, especially the White Letter (W-album), in many places common; the others I have found, but more rarely. Bath Whites are by no means a rarity, and in Switzerland can be met with every day, though they seem to be somewhat local. The butterfly that caused me most pleasure was my first Apollo, whose total dissimilarity to any species I had before taken caused me much surprise, as well as the crackling noise it made when struggling in the net. They can always be met with in the Swiss mountains on a fine day, but though they are not swift flyers, they then have great facilities for leaving you behind, as they can go in places where it is impossible to follow them; though only just out of reach of the net, they might just as well be thirty miles off, for you can't get at them without a pair of wings. The Jersey Tiger (Hera), which is hardly to be called British at all, may be beaten out of every wild thyme bush by the roadside, and a row of them make a very handsome show in the cabinet. The Skippers are numerous on every patch of grass. One of the best ways of catching moths I know is to wait till a fête night, and then stand by a blue light, which always abound on those occasions, and box the poor beasts that try and burn themselves. They are so intent on achieving their object that this can be done without difficulty. Breeding abroad does not pay, as you have to rush your insects about from place to place, and to feed them on whatever you can get. The only thing necessary for a successful hunt is fine weather; with this, results can in a few days be obtained that would appear to one unaccustomed perfectly marvellous.'

After some remarks from the President on this paper, the Society adjourned to the Physical Science school, where Mr. Hutchinson exhibited Gramme's Electro-magnetic Machine, the most powerful hitherto invented. The following account may be interesting.

The machine heated nearly 20 inches of platinum wire, gave brilliant sparks when one of the terminal wires was rubbed on a file, and easily worked a large Ruhmkorf's coil.

Various 'Geissler tubes' were exhibited, which usually require a coil and battery.

All magneto-electric machines depend primarily for their action upon the law discovered by Faraday in 1830, that the relative movement of a magnet and wire, forming a closed circuit, will produce a momentary current of electricity in the wire.

The earliest machines were those of Saxton, Pixii, and Clarke, in each of which a coil of wire surrounding a bent piece of soft iron, was made to revolve rapidly in front of a magnet, or else the magnet itself revolved in front of the coil.

A great improvement was afterwards made by Siemens, who placed his 'armature,' as the soft iron with its coil of wire is called, immediately *between* the poles of a series of magnets, instead of in front, thus obtaining a more concentrated 'magnetic field.'

In all machines of this kind, however, the currents immediately produced by the apparatus are not only of varying strength, but are in opposite directions during each revolution of the armature, and require to be 'rectified,' or brought into the same direction, by means of a 'commutator,' at which brilliant sparks are constantly passing, with a corresponding expenditure of electrical energy.

In Gramme's machine the armature consists of a circular ring of soft iron surrounded by a continuous coil of insulated copper wire. This ring revolves symmetrically between the poles of a powerful horse-shoe magnet, or series of magnets, and the result is a current of uniform strength always in the same direction, and hence needing no commutator with its necessary spark and loss of energy.

The machine exhibited was made by Breguet, of Paris, and is little more than a lecture-room model. The larger 'Gramme machines' are capable of producing the most brilliant heating and lighting effects, but they require to be worked by steam power. A fine machine of this kind was to be seen at the Loan Exhibition of this year, for producing the so-called electric-light.

Meteorological Observations, 1876.

January.

Date	Barom. Re-duced.	Temperature Dry Bulb.	Wet Bulb.	Max.	Min.	Rain — inches	Date	Barom. Re-duced.	Temperature Dry Bulb.	Wet Bulb.	Max.	Min.	Rain — inches
1	30,044	35,2	35	47,2	35	,16	18	30,097	43	41,8	46,2	40	
2	30,164	27,2	27	36	23	,14	19	30,189	41,2	38,8	50,4	35,8	
3	30,105	44,6	44,2	48,6	44	,01	20	30,815	45,4	43,6	47,2	40,8	,43
4	30,293	39,8	39,8	53	38,6		21	30,732	35,4	35,2	46,4	34,8	,85*
5	30,384	35,2	34	46,4	35		22	30,255	28,2	28	35,6	28	
6	30,489	29,6	28,8	46,4	28	trace	23	30,421	34,2	33	39,2	27	
7	30,418	31	30,2	32,2	26,2	,03*	24	30,426	39,8	38	39,8	34,4	
8	30,115	27	27	34,2	26	,01*	25	30,506	35	34,8	44,2	33,6	
9	30,230	23,8	23,8	29,8	23,2		26	30,335	36	35	44,6	34,2	
10	30,381	32,6	32,4	32,8	30	,06*	27	30,362	40,8	40,4	43	38,2	trace
11	30,275	30,2	30,2	34	30		28	30,318	39,2	39	43,6	39	,01
12	30,253	24,4	24	33	14	,21*	29	30,346	34,2	33,2	43,4	33	
13	30,324	29	29	33,4	29	trace	30	30,293	38,4	38	50,2	33	,03
14	30,555	32	32	32,6	30,8		31	30,385	42	41,8	47,2	41	
15	30,687	31,6	31,2	33,8	30,6		Average						
16	30,537	24	24	31,8	20,4	,01		30,359					Total
17	30,409	36,8	36,4	36,8	33,8	trace							1,95

* melted snow.

February.

Date	Barom. Re-duced.	Dry Bulb.	Wet Bulb.	Max.	Min.	Rain inches	Date	Barom. Re-duced.	Dry Bulb.	Wet Bulb.	Max.	Min.	Rain inches
1	30,148	41,8	40	48	37	,19	17	29,617	49,7	49	53	46	,05
2	30,131	37	36,2	47	34		18	29,430	48	45	53	42	,07
3	30,288	38,6	37	47	32	,17	19	29,273	43,5	40,5	49	34	
4	30,001	33,6	33	40	30		20	29,671	37	30,2	50	37	,03
5	30,032	31	30	37	29	,04	21	29,740	50	49,7	53	43	,02
6	30,005	33	32	36	32	trace	22	29,818	47	45	52	42	,03
7	30,007	34	30	35	29		23	29,616	45,5		47	33	,08
8	30,009	34,6	30	34,6	30	,09*	24	30,050	35,5	33	44	32	,05
9	29,907	32,6	32	34,6	23	,06*	25	29,846	33,7	32,5	43	33	,02
10	29,976	25,6	25	34	20	trace	26	29,508	44	43,5	49	42	,03
11	29,949	19,6	20	32	19		27	29,481	44	42,5	55	41	,01
12	29,935	24,6	24,6	37	24	trace	28	29,725	44,5	42,0	54	43	,01
13	29,774	28	26	35	28	1,70*	29	29,727	51,0	50	55	38	,02
14	29,558	31	30,6	46	31		Average						
15	29,432	46	45,5	51	39	,08		29,314					Total
16	29,612	42	40	50	40	,02							2,77

* melted snow.

March.

Date	Barom. Re-duced.	Dry Bulb.	Wet Bulb.	Max.	Min.	Rain inches	Date	Barom. Re-duced.	Dry Bulb.	Wet Bulb.	Max.	Min.	Rain inches
1	29,677	44	43	49	41,4	,02	18	30,031	32,9	31,8	41,2	27,2	,09
2	29,793	41	38	50	37	,10	19	29,983	33,2	31,8	37,2	24	,02
3	29,661	50,5	38	54,2	42,2	,02	20	30,103	35,4	30,1	39,6	23,4	trace
4	29,668	43,7	39,7	50,2	38	trace	21	29,935	30,5	29	36	27,2	,10
5	29,723	39,5	38	49,6	34	,08	22	29,974	30,8	28,8	40	23	trace
6	29,562	49,5	45	52,2	40,4	,01	23	29,961	33	30,2	45,2	26	,01
7	29,701	40	35,7	46,2	36	trace	24	29,652	38,7	36	49	31	
8	29,666	44	41,5	48,2	35,2	,20	25	29,767	39	36,7	51	31	
9	28,707	35	31	47	32	,05	26	29,671	36,7	32	39	32	,02
10	28,671	36	35	46	31	trace	27	29,514	44,3	38,9	49	31,8	,38
11	29,022	40	37,5	49,2	35	,03	28	29,213	41,7	41,1	54	36,2	,19
12	28,818	33,5	32	38,2	32	,65	29	29,312	44,9	43,7	47,2	40	,25
13	29,607	33,5	31,8	43,2	30	,07	30	29,565	45	42,7	55,2	37	,05
14	29,498	44,9	42,1	52,2	36	,27	31	29,549	47	44	61	40	,02
15	29,183	41,3	39	48,4	35	,01	Average						
16	29,597	38,4	35,2	47,2	33			29,566					Total
17	29,678	35,6	30,9	41,2	27,6	,02							2,66

April.

Date	Barom. Reduced.	Temperature Dry Bulb.	Wet Bulb.	Max.	Min.	Rain — inches	Date	Barom. Reduced.	Temperature Dry Bulb.	Wet Bulb.	Max.	Min.	Rain — inches
1	29,725	42,1	40,5	50	34	,02	18	29,237	46,8	45	55	40	,13
2	30,016	37,6	36,1	61,8	37	trace	19	28,937	45,4	45	55	41	,10
3	30,217	47,5	43	61	36		20	29,205	47	45,2	54	41	,25
4	30,404	52,8	48,9	62,4	41,8	trace	21	29,481	48	46,2	60,2	42	trace
5	30,500	51	49,7	62,2	45	trace	22	29,854	47,8	46	54	38	,08
6	30,442	53	50,7	60	49	trace	23	29,984	47,8	45,8	66	41,4	,07
7	30,402	54	50,7	62,6	47,8		24	30,011	47	45	59	40	,17
8	30,092	52,5	47,3	68	38		25	30,001	50,4	46,8	59	44	,14
9	29,813	50,1	47,3	58,2	45	,09	26	30,172	50,6	45,6	61	38,2	trace
10	29,478	50,3	47	51,6	36	,41	27	29,978	46,2	45,8	55	41,8	,10
11	29,535	36,5	34,2	44,6	31,8	,01	28	29,454	40,8	46	59	40	,03
12	29,856	37	34	45	27,6	,50	29	29,532	49,8	46,2	56,8	41,4	,95
13	29,566	32	31,7	34	31	,32	30	29,757	42	39,8	46	37	trace
14	29,830	37,1	33,3	41	30	,29							
15	30,315	39,9	38	54,4	30	trace							Total
16	30,234	44	41	55,8	29	,01	Average	29,857					3,67
17	29,708	41,7	41	46	37	trace							

May.

Date	Barom. Reduced.	Dry Bulb.	Wet Bulb.	Max.	Min.	Rain inches	Date	Barom. Reduced.	Dry Bulb.	Wet Bulb.	Max.	Min.	Rain inches
1	30,001	42	39	51,2	32	,01	18	30,281	46	41,8	53,4	43	
2	30,192	42	38	48	30,6	trace	19	30,347	46,6	42,8	62	41	
3	30,331	43	39	57,6	29,8		20	30,323	50	44,4	65,6	32,2	
4	30,419	49	45	61,4	33,6		21	30,120	56,8	50	68,8	38	
5	30,367	52,2	45,6	63	38		22	29,799	54,2	50	61	43,6	,06
6	30,264	54,8	47,8	68	39		23	29,735	55	49,2	57	46,8	,03
7	30,347	47	46	59	39,8	trace	24	29,713	50,2	47	61,8	45	,08
8	30,471	47,2	44,2	59,8	35		25	29,838	45,2	42,4	55	42,4	,22
9	30,415	48	44	57,8	35,6		26	29,811	47,2	47	55	43,4	,01
10	30,429	48,4	43	59,2	35		27	29,867	58,2	54	60	46,6	
11	30,239	46,8	42,8	60,4	37,8		28	30,200	55	50,6	63,6	45,8	
12	30,207	48	42,8	57	36		29	30,210	56,2	50	67,8	41	
13	30,299	45,6	41,4	56	34,2		30	30,109	56	51	69	40,8	
14	30,155	48	43	55,2	34,6	trace	31	30,096	53	47,4	62,8	49	
15	30,098	46,6	44	58	41,2								Total
16	30,215	47	43,8	57,6	36,6		Average	30,127					,41
17	30,237	45,8	42,4	57,8	38								

June.

Date	Barom. Reduced.	Dry Bulb.	Wet Bulb.	Max.	Min.	Rain inches	Date	Barom. Reduced.	Dry Bulb.	Wet Bulb.	Max.	Min.	Rain inches
1	30,272	53,5	49,3	71	39		18	29,990	55,1	51,1	60,2	47,8	
2	30,094	59	54	70	54	trace	19	30,125	53,3	50	67,6	46	trace
3	29,844	57	53,5	66	44	,26	20	30,089	68	62	81,2	53	
4	29,898	51,1	46	69,2	42,6	,05	21	29,897	69,1	63	82,4	57	,23
5	29,740	57,1	55,7	62	49	,01	22	29,995	58,7	55,1	66,8	53	,30
6	30,028	56	50,1	64,8	46,2	trace	23	29,988	52	51,3	65	50,4	,16
7	29,975	56,1	52,3	62,6	45		24	29,927	55,7	55	72,8	54	,05
8	29,911	53,1	49,6	60,8	40,6	,16	25	30,025	60,1	55,1	72	50	
9	29,741	52,5	50	64,2	46	,08	26	30,054	55,5	53,8	67,2	53	
10	30,178	50,8	46,1	60,4	45,6	trace	27	30,179	56	53,7	79	51	
11	30,183	54	49,3	72,2	37,2		28	30,143	63	59	79,4	53	
12	30,076	62	57	77	46	,01	29	30,031	56,7	53,5	65	49	
13	30,046	60,8	55	67,8	52	,60	30	29,968	56,4	52	69	45,8	trace
14	30,003	55	51,8	66	46	trace							
15	29,848	54,9	50,8	60	46	,66							Total
16	29,813	50,2	48,9	61,2	47	trace	Average	29,997					2,58
17	29,862	53	50,3	59	47	,01							

July.

Date	Barom. Reduced.	Temperature Dry Bulb.	Wet Bulb.	Max.	Min.	Rain — inches	Date	Barom. Reduced.	Temperature Dry Bulb.	Wet Bulb.	Max.	Min.	Rain — inches
1	29,924	61,5	59,3	70,8	56	,01	18	30,263	64,7	60,1	78	52	trace
2	30,000	60	58	73	56		19	30,104	64,6	59,5	74,6	56,6	
3	30,200	63,1	56,7	73,2	50,6		20	30,243	64,5	59	74,4	54	
4	30,046	61,8	58,8	71,2	58	trace	21	30,179	66	61	85,2	50	
5	29,873	63,5	61	70	59,2	,31	22	30,044	70	64	84,2	59	
6	30,025	61	56,9	75	49		23	29,952	66	60,7	76,6	56	trace
7	29,774	[illegible]	59,3	73,4	57,8		24	30,061	57	55,5	71	55	
8	29,707	64	58,1	72,6	58	trace	25	30,142	61,5	55	79,4	54	
9	29,964	64	58	72,2	52	trace	26	30,040	66,5	60	82	51,2	
10	29,971	57	51	66,4	51		27	30,043	56,2	51,4	70,8	50	,10
11	30,219	56,1	51,1	62	50,6		28	29,828	55,4	52,6	65,4	53	,03
12	30,428	57	53	71	41		29	29,879	58,6	[illegible]	69	51	,26
13	30,397	64	59	81	41		30	29,969	64	57	74,2	52,2	trace
14	30,408	70,5	66	89	54		31	29,679	59	56,8	66	55	,17
15	30,434	72	67,2	90,2	58		Average	30,046					Total [illegible]
16	30,356	72,1	69,2	[illegible]	57								
17	30,236	70,5	65,7	78,2	60								

August.

Date	Barom. Reduced.	Dry Bulb.	Wet Bulb.	Max.	Min.	Rain — inches	Date	Barom. Reduced.	Dry Bulb.	Wet Bulb.	Max.	Min.	Rain — inches
1	29,916	56,8	50,8	67	43,6	trace	18		62	60	67,2	59,4	,23
2	30,043	59,8	54,2	71,6	45	,33	19		60	60	75,4	57,6	,06
3	29,411	62,4	57,4	70	53	trace	20		67	63	74	56,6	,10
4	29,959	57	53,8	64	52	,04	21		65	62,2	78,2	55	,34
5	30,134	57,8	54,6	70	51	trace	22		59,8	57,6	68,4	59	
6	30,265	60,6	56	69	49	,03	23		54	50	68	44	
7	30,145	61,4	59,2	79,2	58		24		55	51	65	43	,02
8	30,174	59	57,4	76	52		25		46,6	50	62	38,2	
9	30,092	66,6	62	84,2	51		26		54	49,8	59,8	45,2	,08
10	30,301	59,8	64,2	70,6	54		27		55	51	62	50	,02
11	30,344	62,6	56,8	81	47,4		28		56	53,6	64	43,8	,32
12	30,245	61,4	59	83,8	49		29		58,6	54	64	53,2	trace
13	29,969	70,8	64,8	93	55,8		30		58	53,2	63,4	51	,29
14	29,930	72,2	65	93	58,6		31		50,8	46,2	56,2	43	,39
15	29,982	62,8	61	86,6	59,6		Average						Total 2,26
16	29,993	72,6	65	87,4	62								
17	29,998	61	58	86	56	,01							

September.

Date	Barom. Reduced.	Dry Bulb.	Wet Bulb.	Max.	Min.	Rain — inches	Date	Barom. Reduced.	Dry Bulb.	Wet Bulb.	Max.	Min.	Rain — inches
1	29,616	54,2	51,4	65,6	48,2	trace	18	29,822	55,4	53	64,6	46	,24
2	29,800	54,8	51,6	63	47	trace	19	30,217	52,4	51,8	66,8	44,6	
3	29,951	55	51	64	48	,47	20	30,379	55,6	53,8	70,2	42	
4	29,670	57,2	57	68	52	,22	21	30,233	56	53,4	72	48	
5	29,553	62	57	68	55	,14	22	30,043	57,6	55	71,2	49	,42
6	29,518	58	55,6	65	56,2	,30	23	29,854	56,4	56	64	55	,35
7	29,542	53,2	53	59,8	51,4	,03	24	29,734	57,4	57	64,8	51	,25
8	29,675	52	49,8	60	45	,01	25	29,754	58,2	54,6	64,2	54	,02
9	29,825	54,8	51,2	58,2	44,2	,11	26	29,702	54,8	54	61,4	50	,15
10	29,787	52,8	50,4	63,4	45,4	trace	27	29,676	53,2	53	58,8	51	,08
11	29,788	52	48	55,2	46		28	29,446	56,2	55,8	56,2	52,4	1,15
12	29,893	50,8	46	53	46	,03	29	29,593	56,4	50,2	61,8	44	
13	29,805	47,8	47,6	53	41	,01	30	29,642	51	49,8	52,4	45	,46
14	29,783	52,6	50	61	47								
15	29,779	50	48,6	66,2	41		Average	29,784					Total 4,65
16	29,682	51	49	56	42,4	,17							
17	29,759	56,2	50	67,2	50	,04							

October.

November.

1	30,331	31,5	29,5	45,4	29		18	30,021	[illegible]	50	54	[illegible]	,22
2	30,328	[illegible]	37	51	30,6		19	29,781	50	49,5	53	44	trace
3	30,249	[illegible]	43	47,4	37,6	,60	20	29,729	45,5	45	48,4	[illegible]	,18
4	30,314	48,9	48	51	[illegible]	trace	21	30,092	40,3	40	46,6	38,6	trace
5	30,306	49,5	49	52	46,4		22	30,243	42,1	41,2	47	[illegible]	trace
6	30,315	41,9	41,5	50	41,6		23	30,180	37,4	35	37,4	34	
7	30,250	32,5	32	48	31		24	30,168	37,8	36,1	38,6	35	,22
8	30,167	[illegible]	29	43,8	28		25	29,493	41,5	41,2	47,8	37,2	,28
9	30,010	33,5	32,5	39,2	31,6		26	29,593	40,5	39,5	51	36,4	,12
10	30,160	29	28	42,4	28		27	29,358	43,8	42,9	48,4	[illegible]	trace
11	30,045	32	32	41	27	,02	28	29,449	38,9	37,8	47	36,2	,02
12	29,368	[illegible]	34	40,2	32,2	,79	29	29,508	35,1	34,5	47,8	[illegible]	trace
13	29,477	39,7	39,5	42,2	34	,07	30	29,708	35,5	33,1	44,4	32,8	,21
14	29,577	45,5	45	56,6	41	,25							
15	29,496	51	50,6	63,2	47	trace							Total
16	29,370	53	51,5	63	44,2	,02	Average	29,894					3,00
17	29,757	48,5	47	58,2	47,4	trace							

December.

1	29,375	50,4	49,5	53,8	41	,02	18	29,383	40,2	40	40,8	39	,01
2	29,268	48	47	51,2	47,2	,52	19	29,106	39,6	39,6	41,2	38,4	,31
3	28,991	51,5	50	54	46	,37	20	28,751	40,6	40,2	46,2	39	,16
4	28,482	48,5	47,1	48,8	46,4		21	28,751	38,4	38	39,8	36	,01
5	29,085	46,7	45,4	48,8	44,4		22	29,129	36,4	35	43,2	31	,02
6	28,972	43,8	41,7	52	42,8		23	29,393	29	29	43,2	27	,15
7	29,208	44,6	42	46	41		24	29,539	[illegible]	32,8	[illegible]	31,6	,09
8	29,616	44	43,2	46,8	40	,15	25	29,845	32,2	32	32,4	31	,03
9	30,149	36	35,4	44,6	34,8	trace	26	30,191	27	27	34	27	,21
10	30,181	43	41,2	44,2	41,2	trace	27	29,675	[illegible]	[illegible]	55,2	29	,16
11	29,770	42,2	39,6	44,8	41,8	,01	28	29,600	55	53,6	56	51	,15
12	29,675	43,6	42,4	46,4	[illegible]	,19	29	29,764	39,2	39	51,2	38	,31
13	29,814	33,6	33,2	46,2	33	,01	30	29,511	46	45,8	51,6	41	,66
14	29,988	40	39	41,8	35		31	29,151	[illegible]	47	52,4	45,4	,20
15	29,735	39,4	37,6	43	38,4	,02							
16	29,802	[illegible]	42	43,6	39	,25	Average	29,480					Total
17	29,727	41,8	41	43,2	41	,17							4,18

Meteorological Section.

In printing the Meteorological Observations for the last year, it has been thought advisable to return to the previous practice of giving the readings of the wet and dry bulb thermometers, instead of only recording their difference.

A new feature in the Report will be found in the Meteorological Chart for 1876, shewing at a glance the variations that have taken place in temperature, barometer, and rainfall during the year. In the upper part of the chart, the middle line shews the daily temperature at 8.15 a.m. The highest line gives the reading of the maximum thermometer taken at 9 p.m. on the same day, and the dotted line shews the lowest temperature during the previous 24 hours.

The remarkable fall of the barometer on December 4th, 1876, should not be passed over without a word. It is probable that the level of the mercury was lower on that day than it has been at Rugby for half a century.

The actual reading of the instrument at 10 a.m. December 4th was 27.950 inches, which, corrected for pressure and temperature gives 28.316 inches. Immediately after 10 a.m. the mercury began to rise.

The lowest readings previously recorded at Rugby for the last 13 years are the following:—

January 24, 1872, 8.30 a.m.	..	28.438	inches.
{ January 19, 1873, 11 p.m.	..	28.384	,,
{ January 20, 1873, 9 p m.	..	28.377	,,

Mr. Symons, in a letter to the *Times*, stated that his instrument at Camden Square gave 28.364 inches as the corrected reading at 11 a.m. on December 4th, and that only upon two occasions had his barometer been lower for the previous 50 years, viz. on January 13, 1843, when the corrected reading was 28.266; and January 24, 1872, when it was 28.332. On January 20, 1873, his corrected reading was only 28.447.

The rainfall for the year was 30.64 inches, being rather more than 7 inches above the average of the last 25 years. In 1875 it was 35.78 inches, more than 12 inches above the average. The amount of rain that fell during the month of December, 1876, was 4.18 inches. The wettest month was September, when the amount reached 4.65 inches.

It may not be generally known by the members of the Society that the work of the Meteorological Section embraces a wider range of observations than those actually recorded in the pages of this Report. In addition to those observations, the following are taken daily: Additional dry and wet bulb readings each evening at 9 p.m.; minimum-on-grass thermometer; direction and force of the wind; amount and description of cloud; direction of movement of upper stratum of cloud; state of the weather at the time of observation; character of the weather since last observation.

The whole series of observations are then entered monthly on a large printed form supplied by the Weather Office, and sent up to the Director, Mr. R. H. Scott, the barometer readings having been pre-

viously reduced for pressure, temperature, and height above sea-level, and the average daily reading computed.

It has not been thought necessary, however, to take up the space that would be required in our Report if we were to print a complete copy of the actual chart sent up to the Weather Office.

At the end of the Report last year, I drew attention to the fact that there had been a falling off in the number of volunteers for taking the monthly observations.

I have no reason to complain of any difficulty in obtaining workers during the past twelve months, but I wish particularly to call attention to the necessity for care and accuracy in carrying out whatever portion of the observations any one boy may undertake. A slip in a carelessly made figure—an entry omitted, or placed to the wrong day—a rain gauge reading entered ·1 instead of ·01, may, and would, unless discovered and corrected, seriously diminish the value of the entire observations for the month.

Had it not been that, fortunately, I have for many years taken an independent series of observations with my own instruments, I should not have been able to detect several such slips as those to which I have referred. If all the observations were taken by a single boy, it would be easy to look him up, and see that his work was correct. But when one individual has charge of the barometer, another of the thermometer and rain gauge, another of the weather, *i.e.* wind, cloud, &c., another of the evening readings, and, as has lately been the case, another of the weekly report for one of our local papers, it is evident that much time may be lost in looking up these various assistants, and discovering where they have gone wrong.

However, I will only add that whatever is worth doing at all is worth doing well: and as I am quite sure that this work *is* worth doing well, and that the kind of training and accuracy it requires will be well worth whatever small sacrifice of time it may involve, I shall hope to see the old workers again offering themselves for fresh work, and new ones volunteering to take the place of those who have left us.

Subjoined are the names of those who have assisted during the past year.

M. M. Adam	G. S. Ogilvie
W. Browett	T. B. Oldham
W. E. Home	C. L. Sandars
C. B. Hutchinson	W. H Simpson
H. Lund	J. C. Thornhill
M. J. Michael	H. V. Weisse

Mr. Kirk has again assisted by taking the readings during the vacations.

Our thanks are also due to Mr. Percy Smith for much help in reducing the observations, and entering them in the monthly sheets sent up to the Weather Office.

T. N. Hutchinson.

Report on the Temple Observatory.

The instruments in use at the Temple Observatory are the same as those described in previous reports, with the exception of some additions to the spectroscope, hereafter to be described; and all are in good order.

The measurement of double stars has continued to occupy the attention of the observers: but the unfavourable weather has prevented the measurement of a long series. The number measured is 189, consisting principally of stars of which no recent measures appear to have been taken, and of which the physical connection is doubtful.

Mr. Gledhill and Mr. Wilson have prepared and published a list of binary stars in the Astronomical Notices, which will be of use to observers. It is preliminary to a work on this subject which is now approaching completion.

The number of visitors recorded is 102, but there appears to have been some irregularity in the entering of names, and the actual number is somewhat larger. Among objects examined by visitors may be mentioned the moon, several of the planets, nebulæ, clusters, double and multiple stars, and star spectra.

The observations of the chromosphere of the sun have been discontinued, the subject having been taken up at Greenwich and other observatories where there is more leisure for routine work. The reflector has therefore become available for observations on the spectra of stars, with a view to determine their motion to or from the earth. The mirror has been re-silvered, and new micrometers made by Mr. Seabroke, for measuring the minute distances between the spectral lines of the stars and those of the hydrogen or magnesium of comparison. A dispersive power of four prisms, with a three-quarter inch collimator of 6 inch focus, is generally used.

After trying a number of forms of battery for controlling the clock, a very simple one is found the best for our purpose: it consists of a zinc rod in a porous cell, standing in an ordinary jam pot. Around the cell are packed a quantity of cinders, with a piece of gas carbon with a wire attached partially immersed in them. A solution of ammonium chloride fills the cell and jar half full. This battery lasts for some six months; the circuit is closed for just half the time, in fact during every alternate second.

A new pendulum has been constructed for a clock to keep mean solar time in the new observatory. The pendulum is of well-seasoned deal, coated with hot paraffin. Acting on the suspending spring is a moveable slide, whereby the rate of oscillation can be varied without stopping the clock to screw up or down the pendulum bob.

Mr. Seabroke completed during the year a siderostat carrying a 12-inch mirror. The difficulty of constructing a perfectly flat surface is so great that it is not expected that this one will be sufficiently good for very accurate work.

Mr. Lockyer has given to the observatory an early astronomical work.

Otto von Struve, Director of the Imperial Russian Observatory at Pulkowa; Dunér, Director of the Swedish Observatory at Lund; and Lord Lindsay, of the Dunecht Observatory, Aberdeen, have presented the School with copies of their very valuable recent works on Double Stars.

We are happy to announce that the Governing Body have purchased a site for the observatory and curator's cottage, and that funds are being collected for these buildings.

Mr. Joseph Clarke has prepared plans, from the designs of Mr. Wilson and Mr. Seabroke, which will shortly be submitted to the Governing Body: and it is hoped that before the appearance of the next Report the buildings will be completed. About £200 is still wanted.

J. M. WILSON.
February, 1877. GEO. M. SEABROKE.

P.S.—*May*, 1877. All the money has been subscribed. The buildings are to be finished by September 1.

Botanical Section.

The Report of the Botanical Section for 1876 cannot be considered so complete or satisfactory as in previous years, owing to the loss the section has sustained in H. W. Trott, who left us at Midsummer last, and who, indeed, during the whole year had too little time at his disposal for carrying on the work of the section. He nevertheless struggled manfully, and working almost single-handed, has left behind him very valuable work, in the shape of additions to the knowledge of our local flora, which are embodied in this report.

The thanks of the Society are due to Mr. Bagnall, the secretary of the Birmingham Natural History Society, for the list of localities of new or rare plants observed by members of that society as growing in the Rugby district.

The section has in the course of last term made considerable progress in arranging the local botanical album begun under the auspices of Mr. Kitchener, continued by Trott, and since his time by various associates of the Society, to all of whom the thanks of the Society are due. We hope that before the issue of our next Report, the album will have been placed in the Society's room in a tolerably complete state.

We are bound to place here on record the chief want of the section, which is, as heretofore, more workers, and especially more observers. Although about 430 plants were recorded last year, many of them were well in flower or nearly over before noticed, and records so obtained are less valuable than those taken *at the time* of the flower's first appearance, at least for purposes of comparison with other years. The number of observations of plants in flower in November was extremely small, for the same reason, although probably the very wet autumn contributed something to the effect, both by diminishing the number of plants actually in flower, and the comfort of searching for them.

The following is a list of new plants and new localities observed during the past season:—

Ophioglossum vulgatum. New locality for this fern is, spinney belonging to Mr. Lines, on the right hand side of the Blue Boar lane, about 50 yards from the road, some 400 or 500 yards past a small farm house on the right of the road. The ferns are growing rather abundantly near the further (west) end of the spinney; April 29, 1876.—Also, the same fern is growing [last observed there by Hodgson in 1871] in the meadow this side of Rainsbrook, beside the Barby Road, about 30 yards from the road (right hand side), and 4 yards from the brook; April 23. H. W. T.

Berberis vulgaris. New locality, right hand side of road leading from Little Lawford Mill to Kings Newnham, about 400 yards from the mill; June 3. L. C.

Rosa pulverulenta. New plant, discovered last year, 1875, by the Rev. A. Bloxam, in Cathiron Lane, near Harborough (omitted from last year's Report).

Carex strigosa. The plant found in Frankton Wood and reported as *C. strigosa*, was a specimen of *C. sylvatica.* *C. strigosa* therefore to be struck off the list. H. W. T.

Carex remota. New locality (?), Coombe Wood, both Brandon and Brinklow ends; July 8. H. W. T.

Carex ovalis. New locality (?), Coombe Wood, beside a path at right angles to "twelve o'clock drive," leading westward from it; July 8. H. W. T.

Aira flexuosa. New locality, Coombe Wood; July 8. H. W. T.

Serratula tinctoria. New locality, Coombe Wood, path at right angles to "twelve o'clock drive," leading westward from it; July 8. H. W. T.

Rumex conglomeratus. Has only been recorded once or twice; July 27, on the side of the new canal near Harborough. H. W. T. (Apparently rare here.)

Senebiera coronopus. New locality, roadside, on the right, leading from Hillmorton to Barby, at the bottom of the first hill, soon after passing a barn on the right, and 9 yards past a very small oak tree on the same side of the road. Also a single specimen near a farm house beside a bridle path leading from Barby to Dunchurch; a little north of the canal, and about one mile from Dunchurch; August 5. H. W. T.

Triglochin palustre. At intervals along the edge of the canal between Hillmorton and Barby Road; August 5. H. W. T.

Holcus mollis. Locality, spinney belonging to Mr. Caldecott, a little beyond Little Lawford Mill, on the road to King's Newnham. It has been recorded in 1871, but the locality not preserved. July 27. H. W. T.

Triticum caninum. Observed in a ditch on the right hand side of the Barby Road, just after passing the canal, by H. W. T.; August 5.

Sparganium simplex. Two new localities, pond near Frankton Wood, and pond in a field between Little Lawford Mill and Mr. Caldecott's lime works, perhaps three or four fields from the latter; August 1. H. W. T.

Lotus tenuis. Growing in a ditch just outside Birdingbury Station: the *Carduus eriophorus* was observed at the same place and time; August 12. H. W. T.

Lactuca muralis. New locality, in great abundance on the Avenue Road, past Bilton, between the first and second milestones after leaving the Blue Boar, in the direction of Coventry; August 12. H. W. T.

Linaria minor. Right hand side of the lane between the Avenue Road (past Bilton) and Bourton, just before reaching the second gate; August 12. H. W. T. Also in a cornfield between the Newbold and Lawford footpaths.

Myriophyllum spicatuum. New locality, pond close beside Mr. Caldecott's spinney, beyond Little Lawford, in the direction of King's Newnham. It was reported in 1867, but locality not given. July 27. H. W. T.

Aira caryophyllea. The plant recorded in last year's notices as *Aira caryophyllea* is really *Aira flexuosa*; it appears to be not uncommon: it has been observed in several localities this year. *A. caryophyllea* has not yet been observed by any of our own Society, but only by the Birmingham Natural History Society. H. W. T.

Salix Hoffmaniana. New locality, beside small pond in field to the right of the lane leading down to Mr. Caldecott's limeworks, beyond Lawford, about 200 yards from the lane; August 1. H. W. T.

Carex muricata. Recovered to the list, growing in the next field to *Salix Hoffmaniana*, in the direction of Little Lawford, also in the disused limeworks beyond Little Lawford, about 100 yards from the road, and near a large hawthorn bush; August 1. H. W. T.

Bidens cernua. Only locality known, pond in field close to Bilton Church. Observed there by H. G. W., but the locality has not yet been published. In fair quantity at the end of the pond nearest to the church; September 17. H. W. T.

Linaria cymbalaria. New locality, growing on the wall of School House garden opposite Mr. Green's house, 8 or 9 feet from the ground; January 19, 1877. H. W. T.

Mr. Bagnall (Hon. Sec. Birmingham Natural History Society), has also kindly sent us the following localities for new or rare plants:—

June 18, 1876.

Carex pallescens. Dukes Wood and Princethorpe Wood, and Coombe Woods, Brinklow end. New plant to the district.

Kœleria cristata, var. *gracilis.* Lane from Princethorpe to Frankton. New plant.

Poa rigida. New plant, same locality.

Poterium sanguisorba. Same locality, new locality.

Rubus cæsius, var. *agrestis.* New plant. Bourton Heath.

Rubus guntheri. Frankton Wood. New plant.

Rubus hystrix. Frankton Wood. New plant.

Senebiera coronopus. Near Princethorpe. New locality.

Lepidium Smithii. Near Princethorpe. New locality.

Lithospermum arvense. Cornfield near Princethorpe. New locality.

Galium elongatum. Near Withingbrook. New plant.

Mentha rubra. Same locality. New plant.

The November list for last year is very small. They are Nos. 28, 134, 178, 207, 230, 300, 712, 734, 684, 685, 694, 964, 992, 757, 774, 874, 1530, 1598, in the last published catalogue of plants.

Entomological Section.

We are glad to notice an improvement in the work of this section this year, as there have not only been more observers, but their obser-

vations have been more regular and valuable. We still think that we might receive more assistance from the associates of the Society, in the way of recording appearances. The following is the record of appearances: comparison has been made, whenever possible, with those of last year.

The observers are designated by the following initials:—A. S., A. Sidgwick; H. F. W., H. F. Wilson; C. B., C. Bayley; M. J. M., M. J. Michael; A. W. P., A. W. Power; H. A. V., H. A. Vicars.

Observer.	Name.	1876.	1875.
M. J. M.	G. Rhamni, and V. Urticae ...	April 2 ...	—
A. S.	V. Polychloros, hib.	" 3 ...	—
"	O. Stabilis	" 3 ...	—
M. J. M.	H. Lupulinus	" 21 ...	—
"	C. Fluctuata	" 30 ...	—
A. S.	A. Putris (bred)	May 5 ...	June 19
M. J. M.	S. Certata	" 5 ...	—
"	D. Pudibunda	" 5 ...	—
"	P. Rapae	" 8 ...	—
A. S.	P. Napi	" 11 ...	—
"	P. Brassicae	" 11 ...	—
"	C. Vinula (bred)	" 12 ...	—
M. J. M.	C. Unidentaria	" 20 ...	—
"	C. Ferrugata	" 20 ...	—
"	P. Bucephala (bred)	" 20 ...	—
"	C. Spinula	" 21 ...	—
A. S.	R. Crataegaria	" 22 ...	June 10
M. J. M.	P. Formicalis	" 28 ...	—
"	A. Corticana	" 28 ...	—
A. W. P.	S. Tiliae (fresh)	" 28 ...	—
C. B.	A. Cardamines	" 28 ...	—
"	S. Populi (fresh)	" 29 ...	—
A. S.	S. Fabriciana	" 29 ...	—
H. F. W.	M. Fluctuata	" 31 ...	—
A. S.	E. Dolobraria (bred)	June 1 ...	—
"	M. Persicariae (bred)... ...	" 1 ...	June 21
H. F. W.	O. Sambucaria (larva) ...	" 2 ...	—
M. J. M.	M. Biriviata	" 3 ...	—
"	E. Albulata	" 3 ...	—
"	E. Exiguata	" 3 ...	—
"	H. Megaera	" 3 ...	—
"	L. Didymata	" 4 ...	—
C. B.	A. Grossulariata (larva) ...	" 4 ...	—
H. F. W.	S. Clathrata	" 4 ...	—
M. J. M.	M. Brassicae	" 5 ...	—
"	C. Bilineata	" 10 ...	—
"	M. Montanata	" 10 ...	—
"	C. Russata	" 10 ...	—
"	H. Arbuti	" 10 ...	—
C. B.	P. Alexis	" 10 ...	—
"	H. Janira	" 10 ...	—
"	X. Polyodon	" 11 ...	June 18
M. J. M.	C. Lemnata	" 11 ...	—
"	D. Umbellaria	" 11 ...	—
"	C. Corylata	" 11 ...	—
H. F. W.	X. Hepatica (?)	" 13 ...	—
"	H. Humuli	" 14 ...	June 21
C. B.	S. Lubricipeda	" 14 ...	—

Observer.	Name.	1876.	1875.
C. B.	C. Bilineata	June 18 ...	—
A. S.	B. Betularia	„ 18 ...	—
C. B.	S. Menthastri	„ 19 ...	—
M. J. M.	A. Polydactyla	„ 19 ...	—
„	S. Potamogata	„ 20 ...	—
„	S. Olivalis	„ 20 ...	—
„	A. Psi	„ 24 ...	—
„	M. Persicariae	„ 24 ...	—
„	V. Atalanta	„ 24 ...	—
H. F. W.	D. Pudibunda	„ 25 ...	—
C. B.	T. Pronuba	„ 26 ...	June 1
H. F. W.	A. Exclamationis	„ 26 ...	„ 18
M. J. M.	L. Pectinitaria	„ 27 ...	—
C. B.	X. Lithoxylea	„ 27 ...	June 30
„	H. Oleracea	„ 27 ...	„ 19
„	C. Cubicularis	„ 28 ...	—
M. J. M.	S. Viridana	„ 29 ...	—
„	P. Iota	„ 30 ...	—
„	Y. Elutata	July 1 ...	—
„	C. Umbratica	„ 2 ...	—
„	P. Chrysitis (bred)	„ 3 ...	—
„	O. Potatoria (bred)	„ 3 ...	—
A. S.	Z. Æsculi	„ 4 ...	—
M. J. M.	X. Hamana	„ 6 ...	—
„	X. Polyodon	„ 8 ...	June 18
A. S.	C. Pusaria	„ 8 ...	—
„	T. Viridana	„ 8 ...	—
„	A. Paphia	„ 8 ...	—
„	P. Marginata	„ 8 ...	—
„	P. Pterodactylus	„ 8 ...	—
M. J. M.	T. Amataria	„ 9 ...	—
„	M. Unangulata	„ 10 ...	—
„	P. Pentadactylus	„ 10 ...	—
„	H. Padella	„ 10 ...	—
„	H. Thymiaria	„ 11 ...	—
„	L. Marginata	„ 11 ...	—
„	B. Neustria	„ 11 ...	—
A. S.	B. Perla	„ 11 ...	—
„	P. Quercana	„ 11 ...	—
„	H. Nymphiata	„ 11 ...	—
„	H. Stagnata	„ 11 ...	—
„	P. Syringaria (also 15th) ...	„ 12 ...	—
„	T. Forsterana	„ 12 ...	—
H. F. W.	P. Palpina	„ 12 ...	—
M. J. M.	A. Caja (bred)	„ 12 ...	—
„	T. Fuscipunctellus	„ 13 ...	—
„	S. Lacunana	„ 13 ...	—
„	E. Ministraria	„ 13 ...	—
„	C. Pyraliata	„ 14 ...	—
„	H. Tithonus	„ 15 ...	—
„	B. Verticalis	„ 15 ...	—
„	R. Crataegaria (2)	„ 15 ...	—
C. B.	O. Sambucaria (bred, see June 2)	„ 15 ...	June 30
M. J. M.	L. Complanula	„ 16 ...	—
„	S. Populi	„ 16 ...	—
„	C. Ligniperda (bred)	„ 16 ...	—
„	M. Ocellata	„ 17 ...	—
„	M. Rubiginata	„ 17 ...	—

Observer.	Name.	1876.	1875.
M. J. M.	L. Fulvaria	July 17 ...	—
„	C. Tristellus	„ 17 ...	—
„	C. Culmellus	„ 18 ...	—
A. S.	S. Salicis	„ 18 ...	July 2
„	O. Sambucaria	„ 18 ...	—
„	P. Variegana	„ 19 ...	—
„	P. Forficalis	„ 19 ...	—
M. J. M.	A. Emarginata	„ 19 ...	—
„	A Bisetata	„ 19 ...	—
„	A. Remutata	„ 19 ...	—
„	M. Margaritaria	„ 19 ...	—
„	E. Mensuraria	„ 22 ...	—
„	H. Proboscidalis	„ 22 ...	—
„	B. Perla	„ 23 ...	—
A. S.	M. Maura	„ 26 ...	—
„	H. Proteus	Sept. 18 ...	—
„	A. Aprilina (pupa)	„ 18 ...	—
„	S. Tiliae (pupa)	„ 20 ...	—
„	M. Persicariae (larva) ...	„ 21 ...	—
„	P. Meticulosa (pupa)... ...	„ 21 ...	—
„	P. Meticulosa (bred) (2 brood) ...	„ 24 ...	June 17 (1)
„	A. Aprilina (bred)	„ 25 ...	—
„	M. Stellatarum	Oct. 3 ...	—
„	D. Pudibunda (larva) (also 12th)	„ 4 ...	—
„	B. Betularia (larva)	„ 10 ...	—
H. A. V.	V. C.-album	„ 12 ...	—

The advantage of a parallel list must be apparent, as fixing, or at any rate tending to fix, a limit to the time during which an insect can be caught. There is no more useful work than the formation of such a list, and its chief recommendation is its easiness. The only apparatus required is one of the Entomological lists (to be procured from the President) and a pencil. The result appears above.

Good work has been done in the smaller families, and many omissions have been filled up by donations; but much remains to do, and any help will be gratefully received. The following suggestions are here reprinted from a paper on the work of this section read during the Winter Term by the President.

(1.) First, there is a register of appearances. Everybody, whether he collects or not, can enter the date of any observation he makes on any beast he knows by sight. Up to this year, our register has been miserably poor. I know by experience that it costs a little trouble to keep a list, and always put down what one sees at once. Also, if you don't put it down at once, you forget it. My own list this year is as long as the whole list last year, and twice as long as that the year before. And there have been several others at work this year, so that this year there is a far better show of records than we have yet had. We ought in time to get a complete list of all the average appearances of the local list, which would be a very valuable piece of knowledge. The Botany register, published this year, gives the juice of such observations extending in some cases over eleven years, and is really a most praiseworthy result of great care and energy. If we can scarcely hope to rival the work of Mr. Kitchener and H. W. Trott, we can still do something towards it.

(2.) The collections. The long, tedious labour of arranging the British Lepidoptera has been now some time completed. This owed a great deal to the labours of energetic members of the Society, such as Buxton and Vicars, without whose aid it would scarcely have got itself done. We have now set to work with our foreign Lepidoptera, which are tolerably numerous, owing to the kindness of many friends, notably Mr. Kennedy, father of the much-regretted C. M. Kennedy of Mr. Wilson's house. This work is nearly completed.

(3.) It has occurred to me that a very useful collection might be made of cocoons and pupa-skins. It is a great point to know your chrysalis as well as your caterpillar when you see him, especially now in the digging season. With a little care the skin of the chrysalis can be kept with a pin through it, after the moth is gone: and a collection of these would be a novelty, and rather a remarkable one. I will start a box, and ask for contributions. A dead chrysalis which is known, or a shell from which a moth has emerged, with guarantee of accuracy, will be always welcome.

In the other branches almost nothing has been done.

(4.) First come the Beetles. It would be most welcome if any one would take up beetles, and let us have the benefit of his study. There are an immense number of them, about 3 or 4 thousand, and they have one merit, that you can collect them all the year round. They are easier to kill than any other insects—a cup of boiling water, and it is all over in an instant. They are easy to set—having nothing to rub off. They are easy to keep: for if they get mouldy or mitey, plunge them into boiling water again, and there you are. The large collection of Lord Dormer, which is all now in our boxes, ought to be some encouragement to any one inclined to begin.

(5.) Then come the Bees. Of these we know nothing, and yet they are, I believe, very interesting. Several will remember Vicars' very interesting researches into their buzz; but that is the only work that has been done in that department.

(6.) The Spiders, too, I believe, well repay study. They are a little tiresome to keep, for they have to be preserved in spirits. But bottles and spirits are not expensive: and the Society would assist pecuniarily anybody who would collect spiders for it. I should like the Society to have a nucleus at least of a spider collection; and a great many interesting and amusing facts would be learnt by the way. Here again Vicars, by his excellent paper, did a little pioneering: but at present no one has followed.

(7.) There still remain the Dragon-flies, Ants, Diptera, Orthoptera, Bugs proper, or Hemiptera. Of these I will not speak, as I believe we are all equally ignorant. But at least it shews how much remains to do before we have exhausted the Entomology even of this inferior district.

(8.) But besides collections of specimens and dates of appearance, there are also endless special observations to be made. It is impossible to examine any kind of animals or growths for any length of time without either finding out little curiosities of their habits, or coming across exceptional specimens, or noticing some little general fact about them which has not been noticed or explained before. For example, in

Vicars' paper about spiders, there were peculiarities in their behaviour under special circumstances which distinctly added to our familiar acquaintance with those singular animals, besides being amusing. As an illustration of the variation of animals—a most important subject in the present state of Natural History—nearly any queer specimen is worth recording. For example, Hodgson (late member) once found a Meadow-brown, nearly white; a very queer variety. On a Society's expedition a waved yellow moth (a plague for its commonness) was caught with a black band. That was worth recording. Bayley's Convolvulus, with yellow for red on its abdominal markings, is worth recording. In the same way I have ventured to think it worth recording what I have noticed about the colours of Persicariae larvæ. Or again, the Lime Hawk, which spun cocoon instead of burying, or the cases of cannibal caterpillars, were all things to observe. In a word, you may say that nearly any authentic fact about any organic being which is not already well known is worth having, as the raw material of science. And we want as much raw material as we can get.

We subjoin a list of insects bred from pupæ which were dug during two days by the President. This list shews how much can be done with a little patience.

Cerura Vinula.	Axylia Patris.
Orthosia Stabilis.	Eurymene Dolobraria.
„ Instabilis.	„ Depressaria.
Noctua Plecta.	

The cabinet of British Lepidoptera is progressing fairly, though the gaps in the common insects are still obtrusively evident. We hope the coming season may remedy this.

The foreign butterflies alluded to in the President's paper above have now been mostly arranged, and make a very fine show. But we greatly want information about their proper classification and names. Any help towards this end will be most valuable.

Lord Dormer's splendid gift of beetles, mentioned in our Report last year, has been duly arranged in our own boxes.

M. J. Michael has presented us with some valuable foreign insects, and also several species of Depressaria, now in our cabinets.

C. Bayley allowed the Section to choose the gems out of his foreign collection which obtained the prize.

The following notes of various members and correspondents deserve insertion.

(1) M. J. Michael communicates the following List of Insects taken in August in Switzerland.

Rhopalocera.

P. Podalirius	P. Napi	C. Edusa, var. Helice
P. Machaon	L. Sinapis	G. Rhamni
P. Apollo	L. Sinapis, var. Erysimi	M. Athalia
P. Brassicae	C. Hyale	M. Parthenia
P. Rapae	C. Edusa	A. Dia

A. Aglaia	H. Proserpina (Circe)	P. Adonis
A. Niobe	H. Phaedra (Dryas)	P. Corydon
A. Eus	H. Cordula	P. Medon
A. Adippe	H. Janira	P. Oegon
A. Adippe, var. Cleodoxa	H. Tithonus	P. Proto
A. Lathonia	E. Medea	P. Alveus
V. Urticae	E. Pronoe	P. Comma
V. Antiopa	E. Stygne	——
V. Atalanta	E. Nerine (?)	C. Pamphilus
L. Camilla	C. Virgaureae	A. Paphia
A. Ilia, var. Clytie	C. Dorilis	A. Paphia, var. Valezina
L. Hiera	C. Phloeas	V. C.-album
L. Megaera	P. Telicanis	A. Galatea
L. Aegeria	P. Icarus	S. Semele
H. Hermione		

(2) R. H. B. Bolton sends the following note on Spiders.

'One gloomy afternoon in the "vac.," having nothing better to do, I sat down to watch a fine specimen of the "Aranea domestica;" the individual had constructed a most elaborate web outside my window.

'I inserted a fine "Daddy-long-legs" in the web; in a few seconds down came the irate owner, and forcibly ejected the intruder, after biting him and kicking him most viciously, but without much effect.

'I then put a fly into the web, to see if the spider would take any notice of it—I may here mention that I invariably found the spiders very shy, except when actually engaged with a victim—in the present case the spider waited till I was out of sight, and then very rapidly descended to the fly, which he caught and apparently killed (how, I could never quite determine); then, sitting on the corpse, he spun himself round till the fly was completely involved in the web, where he left him for about an hour. As soon as he was hungry he came down and sucked the fly till it looked quite empty, and then kicked it out of the mesh as described in my first letter.

'About a week after this I again went to examine the web, but I found that it was in a most wretched state of repair—there had been several stormy days, and the web had accordingly suffered; but a bad web meant a bad larder; so my friend, seeing that some decisive step must be taken, cast his eyes about him and espied a very nice new web a foot or so distant. Now this spider was a decidedly "muscular Christian," but the owner of the new web was rather a puny individual; so my spider walked up to the web, ejected the owner, and reigned in his stead with every appearance of satisfaction.

'Some days after this again I noticed a remarkably handsome pink and grey spider wandering about; so I captured him (or her), and put him into a box with a glass top. At first he was sulky, and "shammed" sudden death'; but in due time finding that that did not pay, he became intensely active, spinning webs across the box, and kicking at the top of the box: but as soon as I touched the box, or became visible, he resumed the defunct state with the utmost composure. I kept him four days, feeding him on flies—he used to eat about two small house-flies per diem, merely sucking the bodies. One day I found him on his back, kicking himself in the abdomen with much vigour and evident enjoyment: a magnifying glass shewed that he was putting his feet to his

mouth, and then using them as a cat uses her paws in "washing"—the spider having the advantage of being able to use three or four paws at once.

'I am afraid that further observations must be postponed till next summer.'

(3) G. A. Solly supplies this note on Cannibal Caterpillars.

'There were several buff-tip caterpillars in a box, with rather a small supply of food, and at night a small light yellow moth (I don't know its name) was put there. In the morning it was found that only a very little of the moth remained, as almost all of the wings, and part of the body, had been eaten up by these buff-tips. The moth was already dead when it was put in the box.'

A. SIDGWICK.
H. F. WILSON.

Zoological Section.

In this Section very little real work has been done. It is possible to assist in three ways—

(1) Donations.
(2) Observations.
(3) Doing work in the room.

(1) Only two donations of more than one egg have been made: H. Molesworth presented us with a box of eggs, which were most gratefully received; and my own collection was added to the Society's. Amongst the eggs I gave were the following.

Wryneck	Chiff-chaff	Pheasant
Hooded Crow	Lesser Whitethroat	Wild Duck
Carrion Crow	Little Grebe	Snipe
Jay		

Many common eggs are still wanted.

(2) A. C. Chapman has communicated the following List of Birds, chiefly local, from his own observation.

Dates of Birds' Eggs taken by P. H. and A. C. Chapman.

Bird.	1875.	1876.
Kestrel	May 12, 3 fresh eggs ...	None found.
Sparrow Hawk ...	May 20, 4 fresh eggs ...	"
Corbie	Early in May, from 1st to 10th	Same date.
Rook	March 30 and onwards ...	"
Jackdaw ...	May 10, some fresh, some sat upon	"
Green Woodpecker	May 25, rather sat upon ...	June 3, fresh.
Lesser Spotted ditto	May 27, fresh eggs; June 10, found a nest still empty...	None found.
Nightingale ...	May 18, sat upon ...	May 23, eggs sat upon; June 1, young birds.
Blk.-headed Bunting	May 15, fresh eggs ...	May 28, fresh.

Bird.	1875.	1876.
Chiffchaff ...	May 16, hard set ...	Not found.
Tree Pipit ...	May 18, fresh; (also caught a snake on this date) ...	"
Swift	June 5, some fresh, some sat upon	Not taken as yet.
Sand Martin ...	May 30, some fresh eggs, some large young birds...	May 20, plenty of fresh eggs. May 30, " "
Jay	May 20, some fresh, some sat upon	All shot by keepers.
Heron	Breeds during April.	
Coot	May 20, almost hatched.	
Partridge ...	May 25, quite fresh.	
Magpie	Eggs fresh throughout April	Eggs throughout April.
Skylark	June 10, fresh eggs; June 12, nest with large young birds	Not found.
Bullfinch ...	June 8, fresh eggs ...	June 4, fresh eggs.
Whinchat ...	June 12, fledged young birds	Not found.
Swallow ...	June 2, fresh eggs ...	June 3, eggs.
House Martin ...	June 22, fresh eggs ...	Not built yet except in High Street, June 4.
Turtle Dove ...	May 26, fresh eggs ...	Not found.
Blue / Great } Tit ...	May 17, 18, and 20 ...	May 20 again.
Flycatcher ...	June 10 " " ...	June 1, fresh; June 4, fresh.
Redstart ...	June 10, in Green Woodpecker's nest	Not found.
Corn Crake ...	July 10, some fresh, some hard set	"
Reed Warbler ...	At the same time as the reeds themselves are well grown	"
Dabchick ...	May 19 (Willis) ...	"
Blackcap ...	... ...	June 1.
Lesser Whitethroat	... ...	May 24.
Whitethroat ...	... ...	May 23.
Sedge Warbler ...	... ...	May 28, June 1.
Kingfisher ...	... ...	Easter holidays.
Pewit ...	... ...	" "
Long-eared Owl ...	... ...	" "
Water Hen ...	... Throughout May.	
Snipe, Golden Plover, Curlew, Grouse } ...	Easter holidays, end of April and beginning of May.	

H. W. Trott sends the following:

Rooks' nests in trees in Mrs. Tunnard's garden, Bilton road.

In 1872 there was only	1
" 1873 there were	3
" 1874 " "	4
" 1875 " "	7
" 1876 " "	9

I am not perfectly certain whether the first was built in 1871 or 1872. The three last years are right, however. I used to watch them with great interest from my window every morning at about 6.40—6.59, the interval between sleep and early chapel.

C. M. Cunliffe records the Rooks' nests in the Close as follows:

1873	..	89
1874	..	90
1875	..	109
1876	..	107

This latter subject has attracted our attention, and we have had a plate drawn (with the kind aid of C. Kerr, M.) of all the Close trees; and we intend for the future to keep a full and accurate list of all the nests in each tree. See plate 7.

(3) Some little work has been done in the Society's room: the remaining drawers have been partitioned and glazed, and the labelling proceeded with.

One new local bird has been recorded: the Kittiwake.

G. A. SOLLY.

Note by G. M. Seabroke, Esq., on Plate 10.

Each line in the plate represents one observation on the date given in the margin, and is a representation of the ring of the chromosphere with the prominences thereon seen by means of the spectroscope. This ring is supposed to be cut at the N. point, as seen from the earth and straightened to the form shewn. The degrees shewing the position of the prominences read from left to right, and the prominences are represented as they would be seen by an observer on the other side of the sun to the earth. This view is due to the construction of the instrument used. The zigzag line cutting through each observation marks the N. point of the chromosphere referred to the sun's axis.

Description of the Plates.

Frontispiece: A chart of the Meteorological Observations for the whole year, including Thermometer (Wet and Dry Bulbs, Maximum and Minimum), Barometer, and Rainfall for each day. The whole work of reduction and drawing was done by the Rev. T. N. Hutchinson.

Plate 1: Sketch map of Charnwood Forest (Leicestershire) and neighbourhood, drawn by Rev. T. N. Hutchinson, to illustrate his paper on the Minerals of the District. See page 34.

Plates 2 and 3: Drawings of Minerals to illustrate the same paper, page 34; drawn on stone by Rev. T. N. Hutchinson. The full explanation of the plates will be found at the end of the paper.

Plate 4: Drawings of 8 (Foreign and British) Butterflies, to illustrate a paper on 'The uses of Foreign Collections,' page 49. Drawn by H. F. Wilson.

Plate 5: Sketch of a Cat sitting in deserted nest; drawn by an anonymous contributor, to illustrate a paper (by the same person) on Cats, page 2. The incident illustrated is related on page 6. The plate is printed by the papyrograph process, by the President.

Plate 6: Sketch of a Radiometer, to illustrate H. F. Newall's paper, page 16. Drawn by H. C. Clifford.

Plate 7: Plan of the Trees in the Close, drawn with the intention of keeping accurate records of the Rookery. By C. H. M. Kerr.

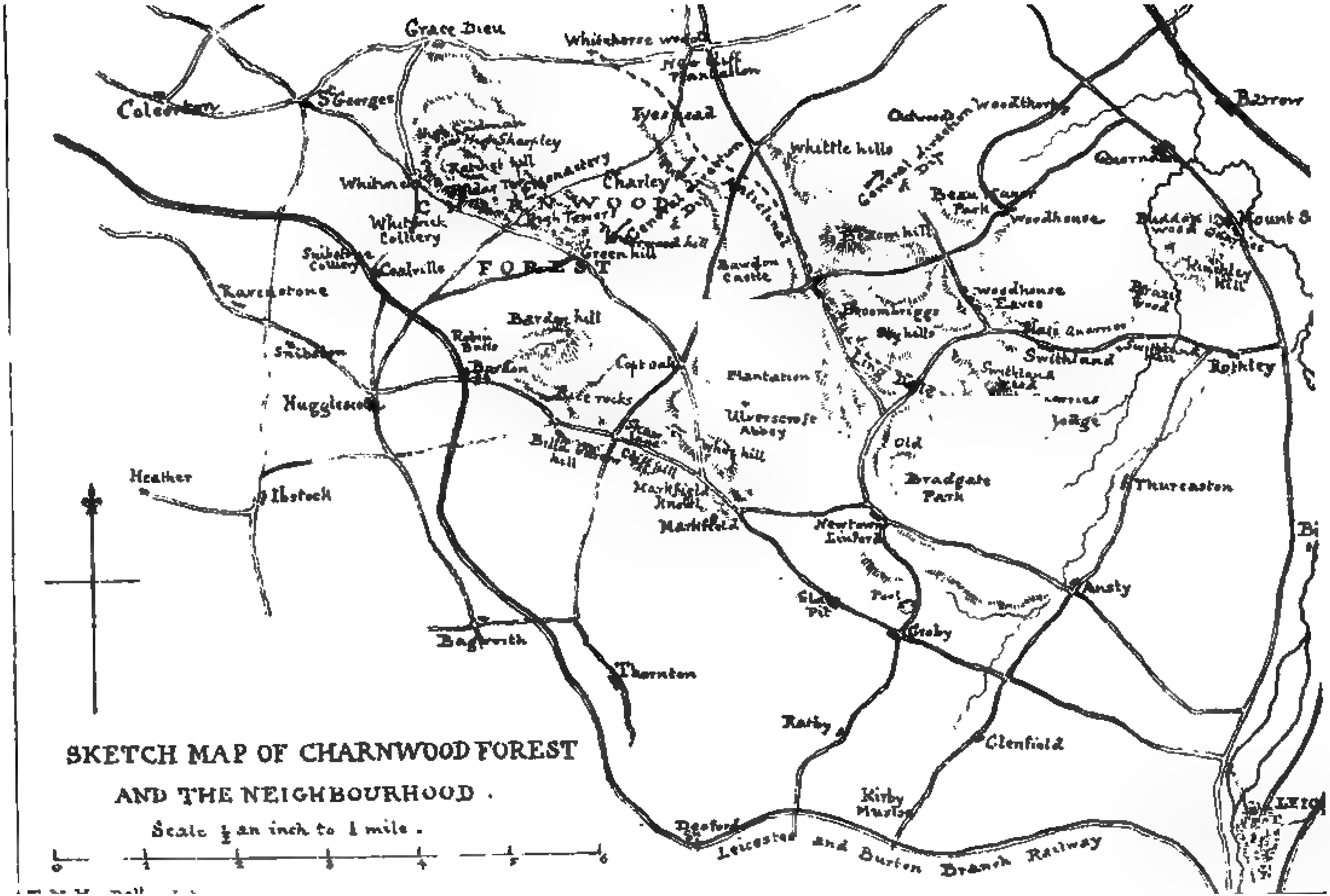
Plate 8: Sketch of three ancient Spurs, of the time of Stephen and Henry VI., drawn from specimens in the collection of M. H. Bloxam, Esq. See a brief account of his exhibition and paper, page 61. By C. H. M. Kerr.

Plate 9: Fig. (1). Fac-simile of the earliest print of Guy Earl of Warwick killing the Dun Cow, from a book of the time of James I. in the collection of M. H. Bloxam, Esq. Drawn to scale by C. H. M. Kerr. See page 52.

Fig. (2). Figure to illustrate H. F. Newall's paper on 'Optical Phenomena,' page 45.

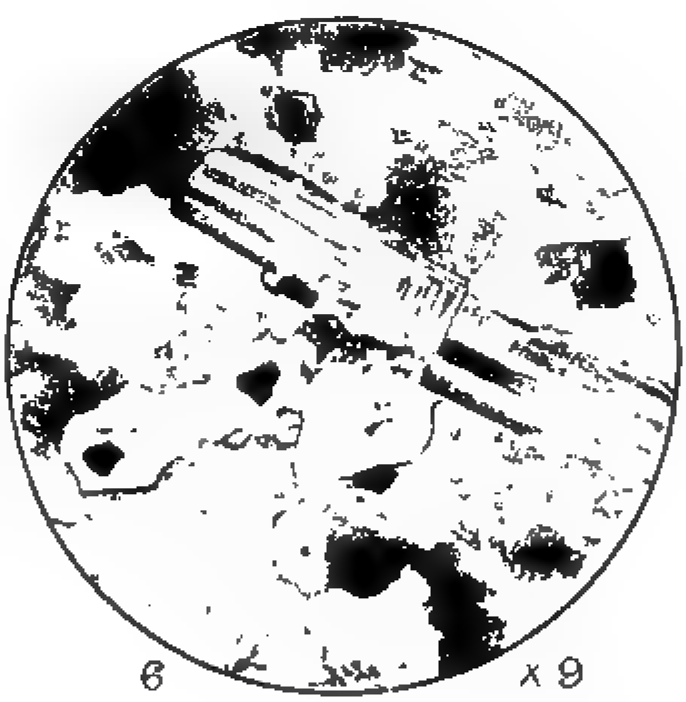
Plate 10: Heliotype of Sun-prominences observed in the Temple Observatory, by G. M. Seabroke. Extracted and copied by Photography from the illustrations to a paper communicated by Messrs. Lockyer and Seabroke to the Royal Society. See page 87.

Printed by W. Billington, Rugby.

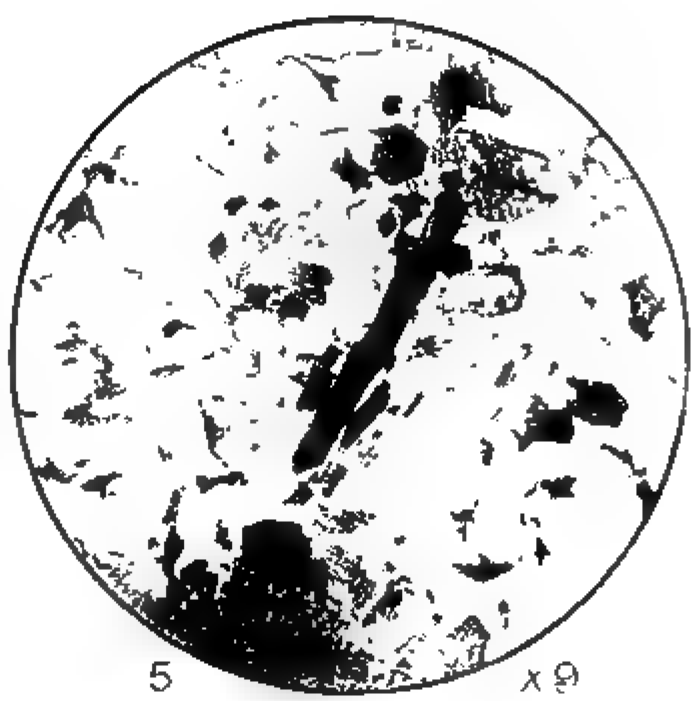


SKETCH MAP OF CHARNWOOD FOREST
AND THE NEIGHBOURHOOD.
Scale ½ an inch to 1 mile.

2 x 9

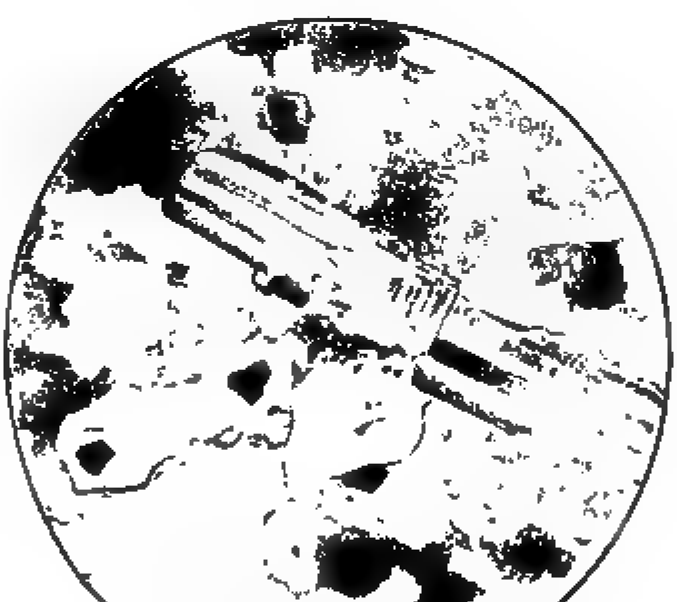


6 x 9

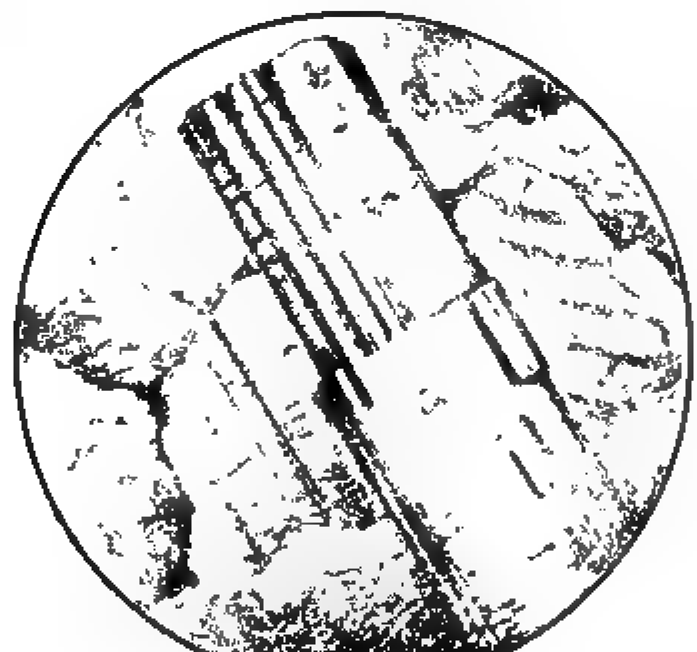


5 x 9

N Hutchinson.



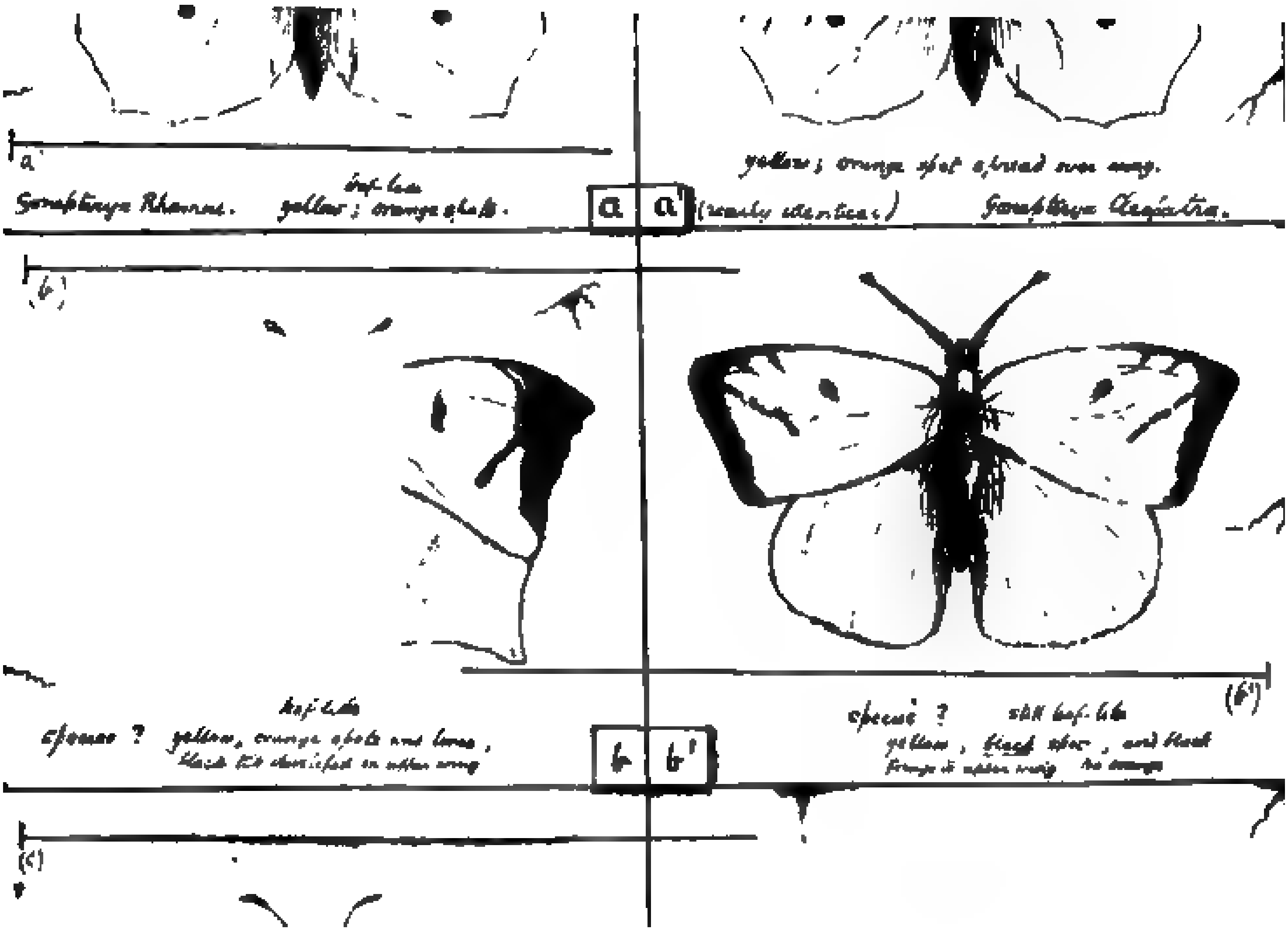
N Hutchinson



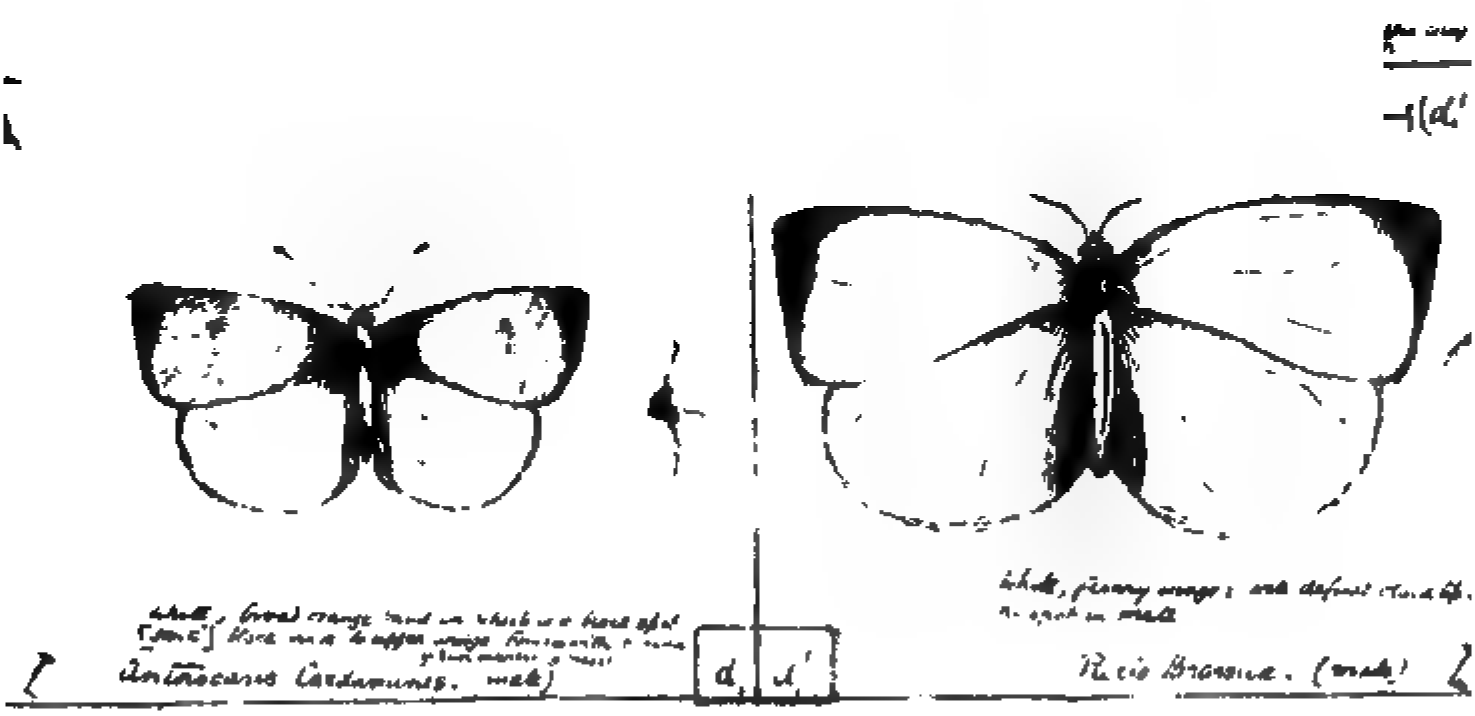
9 x 25

11 x 9

T N Hutchinson De. & L.



a'
yellow; orange spot spread over wing.
Gonepteryx Rhamni.
yellow; orange spots.
a
a'
(nearly identical)
Gonepteryx Cleopatra.
(b)
(b')
species ?
species ?
still leaf-like
b
b'
(c)



Anthocaris Cardamines. (male)
d
d'
Pieris Brassicae. (male)

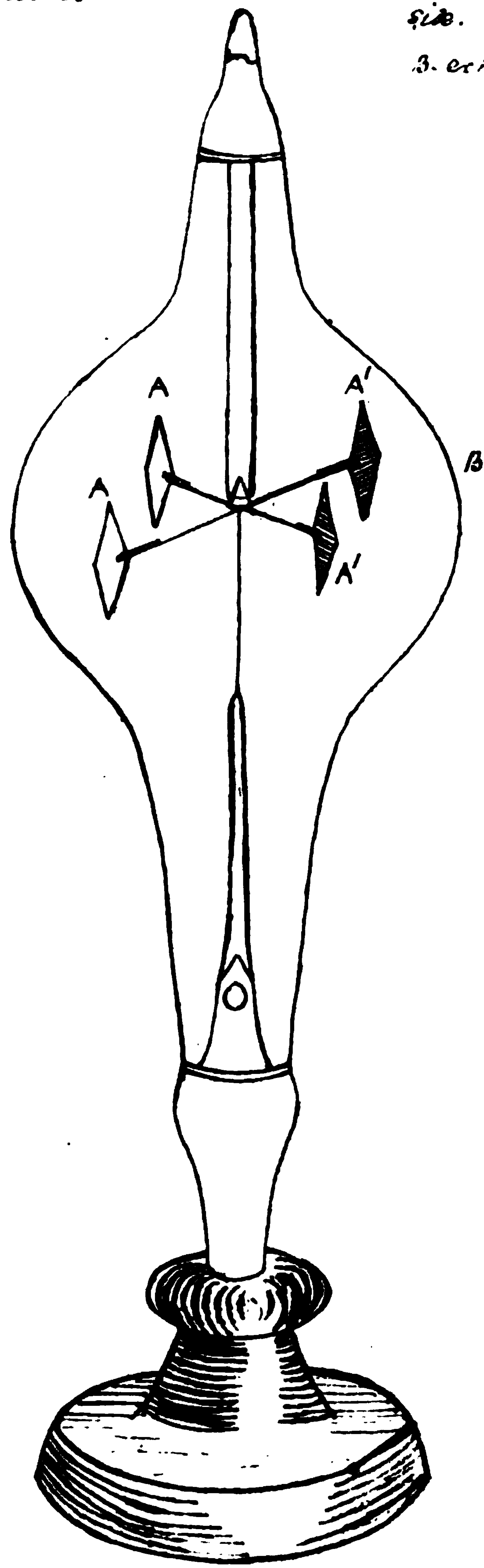
Plate 5

Plate 6.

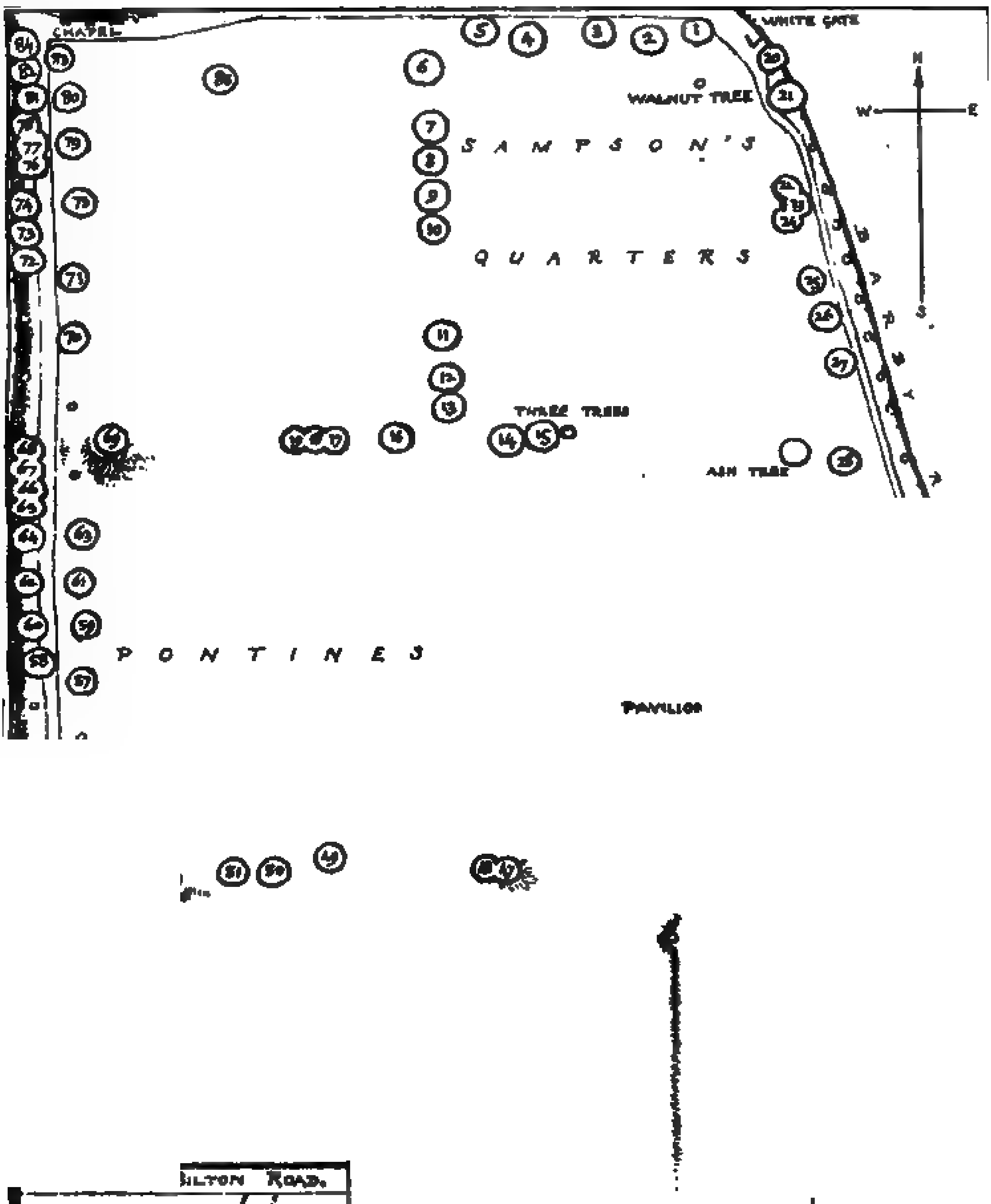
Sketch of the Radiometer,"
to illustrate H. F. Newall's
paper. (p. 16)

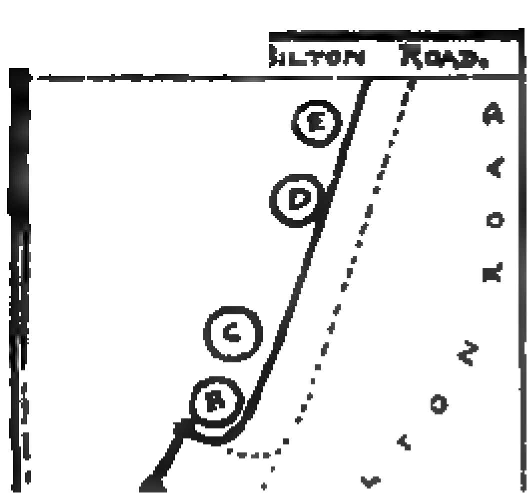
A A A′A′ metal discs
A white side. A′ black
side.

B. exhausted glass case.



H. C. Clifford (A) del:





SKETCH MAP

OF

OLD BIGSIDE.

Plate 8.

1. 2. 3.

Plate 9.

[illegible]

PLATE 1

REPORT

OF

THE RUGBY SCHOOL NATURAL HISTORY SOCIETY

FOR THE YEAR

1877.

"IIS QUIBUS NON CONJICERE ET HARIOLARI SED INVENIRE ET SCIRE PROPOSITUM EST, OMNIA A REBUS IPSIS PETENDA SUNT."

—BACON.

RUGBY: W. BILLINGTON.

1878.

PREFACE.

We are again late in appearing, though we are not conscious of any avoidable delay. The fact is, it takes a long while to print a Report of this length, when both editors and publishers are much engaged with other work.

Making all the allowances which are just, the Society may be pronounced flourishing. Some of the Sections are improved, others have temporarily gone off. The Botany, Geology, and Entomology have improved, or at least not deteriorated: though in all we sadly want more observers. We have a good list of birds from one Zoologist: but no other work at all in that section. In the Astronomical Section we understand there are a few workers, but no results have yet reached us. The newly-started Archæological Section has been vigorous, under the kind direction of Mr. Bloxam. The number of papers read by the present members of the Society has been satisfactory, shewing that the few who do work work well.

By an arrangement with the Curators of the Observatory, we are enabled to present our readers with the Report of that institution, and a plan of the new building.

By the lamented death of the Rev. A. Bloxam, we have lost one of our oldest patrons and supporters: one who has always been ready to give us the assistance of his great botanical knowledge, and has sent us a variety of valuable papers. Mr. Bloxam has also left us some of his botanical specimens.

Mr. M. H. Bloxam has continued to be a constant attendant at our meetings, to the success of which he has much contributed by papers, anecdotes, and exhibitions. He has also been most

bountiful in presenting the Society with various papers and works of his, in giving the Society's prize himself, and in bearing the expense of the improvements now in progress in the Society's room.

The American Geological and Geographical Survey of the Territories have presented us with a long and valuable series of their publications. Owing to the limited space at our disposal, these works are not at present placed in the Society's room: though when we move into more extended quarters, as we hope to do before long, the whole series will be at the service of members.

Among many losses we have suffered in the course of nature, we must mention C. Bayley, a most enthusiastic naturalist, and H. Bashall, a very energetic member. We have also been obliged to accept the resignation of H. F. Wilson, the late secretary, who could no longer spare the time for our work: but his place has been very efficiently filled by our present secretary, G. Jones.

The frontispiece we owe, as before, to Mr. Hutchinson, who has undertaken the whole labour of reducing on stone the year's Meteorological Observations: a most valuable and beautiful piece of work. He has also drawn us the first two plates, which will be appreciated by all our readers. The bulk of the rest we owe to the skill of present members of the School, among whom L. Speed deserves our special gratitude both for the quantity and quality of his work.

Finally, our thanks are due to Lord Leigh, who most kindly opened his woods to our party of naturalists last summer; to Mr. Gillson, who again undertook the entertainment of the party; and to our various other benefactors, both known and anonymous.

A. Sidgwick,
H. F. Wilson, } *Editors.*

Rugby,
June, 1878.

ACCOUNTS.

May, 1877—*May*, 1878.

Cr.	£	s.	d.		£	s.	d. Dr.
Balance, (see last Report)	6	9	3	Plates	3	0	0
Subscriptions	26	17	6	Books, Periodicals, Binding, &c.	17	10	9
Sale of Reports	1	1	6	Repairs, &c. to Room	1	12	6
				Balance	12	5	0
	£34	8	3		£34	8	3

ADDRESSES.

Lithographing: F. Grew, Moor Street, Birmingham.
Anastatic Printing, and Materials: Mr. Cowell, Buttermarket, Ipswich.
Heliotype Printing: H. M. Wright and Co., Lincoln Terrace, Kilburn, N.W.
Entomological Apparatus: J. Gardner, 52, High Holborn, London.
E. G. Meek, 56, Brompton Road, London, S.W.
W. Watkins, Shepherd's Bush.

RULES.

I.

That this Society be called "The Rugby School Natural History Society."

II.

That the Society consist of Honorary Members, Corresponding Members, Members, and Associates.

III.

That Masters, and others connected with the School, or any Benefactor of the Society, be eligible as Honorary, and Old Rugbeians as Corresponding Members; that Present Rugbeians be eligible as Members, or Associates.

Of Officers:

IV.

That the Society's Officers consist of a President, Secretary, and Curator, and of the Keepers of the several Albums, and that these do form the Committee of Management, three to be a quorum.

V.

That all Officers be elected annually.

VI.

That when any office is vacant, the Committee do recommend a Member or Associate, or (for the office of President) an Honorary Member, for election by the Members of the Society, and that the election be by scrutiny.

VII.

That the President take the chair at all Meetings, but have no vote except in cases of equality.

VIII.

That the Secretary keep the Minutes of the Society's proceedings; keep a list of the existing Society, with the names and addresses, as far as possible, of all Corresponding Members, and a list of all Benefactors of the Society.

IX.

That the President and Curator form a Sub-Committee, for managing the finances and keeping the property of the Society.

X.

That the duty of the several Album Keepers be to call together Sectional Meetings; to receive all notices connected with their several Sections; to enter all occurrences of interest in their Album; and at the end of each year to furnish a Report of what has been done in their Section during the year.

XI.

That in the absence of any Officer, the Committee appoint a Deputy.

Of Honorary and Corresponding Members:

XII.

That Honorary Members be elected by open vote of the Society; pay an entrance fee of 10s., but no subscription unless specially called upon; and have all the privileges of Members, except that of voting and of receiving Report gratis: but that Benefactors of the Society who are elected Honorary Members be excused the entrance fee.

XIII.

That Corresponding Members be elected by open vote of the Society, without entrance fee, and have all the privileges of Members, except that of voting; but do not receive the Society's Reports without payment, for a supply of which they may pay a composition.

Of Members and Associates:

XIV.

That Members and Associates be proposed* by a Member or Honorary Member, and the Members elected by ballot, one black ball to three white excluding.

XV.

That the number of Members be limited to fifteen.

XVI.

That no one become a Member or Associate without either paying a composition of 10s., or bringing a note to the President signed by his Tutor to allow a charge of 2s. 6d. per Term to be made in his bill.

XVII.

That Members may speak at all Meetings of the Society; may read Papers with the leave of the President; may introduce one Visitor at all Public* Meetings, and receive a copy of the Society's Report.

XVIII.

That Associates have the same privileges as Members, except the right of voting at Private Business Meetings.

XIX.

That any Member who in the course of the year shall not have read a Paper before the Society, shall require re-election by the Committee.

XX.

That any Member or Associate may be suspended or expelled from the Society by a vote of two-thirds of the Members present, if he, from any misdemeanour, or want of energy, appear to deserve such suspension or expulsion: but such a motion cannot be proposed again during the same Term after it has once been voted upon in a Meeting at which four-fifths of the Members then in residence have been present.

Of Meetings:

XXI.

That Ordinary Meetings be held once a fortnight, but that the Secretary be empowered to call Extraordinary Meetings when necessary.

XXII.

That Visitors may speak and read Papers at all Public Meetings, with the leave of the President.

* It having appeared that Members and Associates have introduced other persons not belonging to the Society into the Society's room, it is necessary to state that this practice is not permitted by the Rules.

Of Reports:

XXIII.

That a Report be printed once a year, or oftener if the Committee think fit.

XXIV.

That an Editing Committee be appointed by the President for each Report.

Of New Rules:

XXV.

That, without notice given at the preceding Meeting, no change can be voted in these Rules, or any vote of Suspension or Expulsion passed.

XXVI.

That no change be made in these Rules, unless proposed by a Member or Honorary Member, and carried by the votes of two-thirds of the Members present.

XXVII.

That in all cases where one vote be wanting to make up a majority of two-thirds of the Members present, the President be allowed to vote.

PRIZES.

The Society gives a Prize (at present £2. to the first, and £1. if a second is adjudged) for an Essay on any subject connected with Natural History. The Prize is decided by a Committee of 2 Honorary and 2 Ordinary Members elected at the first meeting of the October Term. The Essays should be sent in to the President (anonymously) the second Saturday in the October Term, with a sealed envelope, containing the author's name. Preference is given to original work of any kind as compared with matter compiled from books or papers.

Former Winners of the Prize.

1871. 1. H. Ricardo, on *Eyes and No Eyes.*
2. F. R. Hodgson, on *Pets.*

1872. 1. L. Maxwell, on *Spectrum Analysis.*
2. H. N. Hutchinson, on *Motive Power.*

1873. 1. Not awarded.
2. { L. Knowles, on *Coal.* / V. H. Veley, on *Cross Fertilization.* }

1874. 1. V. H. Veley, on *Symmetry in Flowers.*

1875. 1. H. F. Newall, on *Impressions.*

1876. 1. Not awarded.
2. F. G. Hitchcock, on *Dogs.*
Extra Prize. H. L. Stephen, on *Ghosts.*

1877. 1. Not awarded.
2. G. Jones, on *Garianonum.*

LIST OF SOCIETY, JUNE, 1878.

Officers:

President: Mr. A. Sidgwick
Secretary: G. Jones
Curator: T. B. Oldham
Curator of the Aquarium: L. R. Carleton
" " Egg Cabinet: A. S. Maskelyne
Librarian: M. E. Sadler
Album Keepers: Botanical, R. C. Cordiner
" " Geological, T. B. Oldham
" " Archæological, G. Jones
" " Entomological, J. Lea
" " Zoological, E. M. D. Whatman

Honorary Members:

Rev. Dr. Jex-Blake
Rev. T. N. Hutchinson, F.C.S.
J. M. Wilson, Esq., F.G.S., F.R.A.S.
Rev. C. Elsee
Rev. C. E. Moberly
C. Dukes, Esq., M.D.
A. Percy Smith, Esq., F.C.S.
H. T. Gillson, Esq.
J. L. Tupper, Esq.
G. Nutt, Esq.
A. E. Donkin, Esq.
Dr. Sharp
Colonel Carleton
Dr. Mackenzie
L. Cumming, Esq.
J. Collins, Esq.
M. H. Bloxam, Esq.
Rev. C. B. Hutchinson
Rev. P. Bowden Smith
W. C. Michell, Esq.
G. C. Macaulay, Esq.
C. Ransome, Esq.
C. G. Steel, Esq.

Corresponding Members:

Lord Bishop of Exeter
W. C. Marshall
W. C. Eyton
T. G. B. Lloyd, F.G.S.
C. L. Rothera, B. Sc.
E. Cleminshaw
G. B. Longstaff, F.C.S.
F. C. Selous
H. N. Larden
N. Masterman
S. Haslam
G. M. Seabroke
Rev. J. Robertson
R. H. Scott, F.R.S.
W. B. Lowe
F. E. Kitchener, F.L.S.
H. N. Hutchinson
R. H. B. Bolton
H. W. Trott
M. J. Michael
H. G. Wauton

[In the Report Members are marked (M), Associates (A), Honorary Members (H), and Corresponding Members (C).]
Those marked (*n*) have become Associates by note: see rule 16.

Members:

H. F. Wilson
T. B. Oldham
R. C. Cordiner
G. Jones
H. V. Weisse
A. S. Maskelyne
W. E. Home (*n*)
J. Lea (*n*)
M. E. Sadler
H. J. Elsee
L. R. Carleton
E. M. D. Whatman
L. Speed (*n*)

Associates :

T. A. Wise
J. C. Hurle
J. E. Marsh
E. F. Hodge
M. Firth
A. Blakiston
J. O. Fayrer
T. E. Donnison
H. Lupton
R. J. Simey
B. B. Cubitt
F. J. Hirst
F. T. Arnold
F. H. Edwards
R. W. Wilson
W. H. Stone
H. E. Bristow
R. H. Tennant
W. Simpson
J. G. Cobb
A. W. Power
R. Titley
F. J. Hadden
A. T. Keen (*n*)
G. W. Harris
E. Bowden Smith
J. E. Hiron
C. H. W. King
J. C. Thornhill
E. D. Boggs (*n*)
A. Firth
J. H. Newton (*n*)
J. S. Campbell
F. H. Bayley
B. D. Z. Wright
L. A. Adamson
H. C. Clifford
N. F. Jenkins
S. C. Satterthwaite
W. S. Halsey (*n*)
H. S. Fraser (*n*)
J. K. Worthington
F. A. E. Samuelson
F. I. Maxse
G. F. S. Napier
F. D. S. Bentley-Innes
C. D. Bradwell (*n*)
E. B. Ormond (*n*)
K. M. Cox (*n*)
W. L. Behrens
C. Smith (*n*)
H. C. Burnham (*n*)
E. W. Greg (*n*)
E. W. Tobin (*n*)
J. H. M. Ryan (*n*)
F. A. Prevost (*n*)
F. S. Myrtle (*n*)
W. J. Thorpe (*n*)
M. Barnsley (*n*)
G. W. Garnett (*n*)
G. B. Samuelson
J. H. Heycock (*n*)
F. Barkworth (*n*)
J. S. Hoyle (*n*)
J. H. Hale (*n*)
A. J. Hart (*n*)
H. Y. Oldham
B.W.S.Bolland (*n*)
G. F. Underhill (*n*)
B. R. James (*n*)
C. H. Saunders
E. H. Acton (*n*)
H. J. Downing
W. B. Lawless (*n*)
J. B. Allan (*n*)
C. P. Allen (*n*)
H. V. Kilvert (*n*)
P. E. Tooth (*n*)
J.A.McMullen (*n*)
H. M. Baker (*n*)
J. B. Grahame (*n*)
A. M. Grahame (*n*)
R. Bealey (*n*)
W. R. Allan (*n*)
W. Scull (*n*)
S. H. Walrond
W. Ranken (*n*)
H. Macneal
E. A. Haines
W.H.F.Wayne (*n*)
C. H. Brocklebank
W. Tinker (*n*)
C. E. Cobb (*n*)
R. H. Pope
C. A. Bird (*n*)
C. C. Barker (*n*)
A. V. Holland (*n*)
L. Wilkinson (*n*)
W. Maxwell (*n*)
R. S. Smith (*n*)
G. H. Aitken (*n*)
R. H. Landor (*n*)
F. Gillson
H. C. Baker
C. E. Hall
E. St. G. Pratt
C. E. Sayle
E. Solly
A. E. Hart (*n*)
A. Chance (*n*)
A. Castle (*n*)
H.R.Drummond(*n*)
T. Fernley (*n*)
G. Henderson (*n*)
J. F. Moody (*n*)
J. Whitaker (*n*)
H. B. Firth (*n*)
W. Whitelegge (*n*)
S. M. Kingdon (*n*)
H. T. Arnall (*n*)
R. Evans
T. H. Cobb
A. Macrae (*n*)
S. Dugdale (*n*)
J. H. Dugdale (*n*)
J. A. Chanler (*n*)
F. B. Smith (*n*)
H. L. Fowler (*n*)
G. E. Ripley
J. Cartmell (*n*)

LIST OF PERSONS AND SOCIETIES AND JOURNALS TO WHICH COPIES OF REPORT ARE SENT.

Those marked * exchange Reports with us.

The Headmaster
The Chairman of Governing Body
The Bishop of Exeter
Lord Dormer, Grove Park, Warwick
Professor H. J. S. Smith, Oxford
Professor Newton, Cambridge
Rev. J. W. Hayward, Flintham, Notts
Rev. A. H. Wratislaw, Bury
Rev. J. Robertson, Harrow
F. E. Kitchener, Esq., Newcastle, Staffordshire
R. H. Scott, Esq., Meteorological Office
G. J. Symons, Esq., 62, Camden Square
W. Whitaker, Esq., F.G.S., 28, Jermyn Street, London, S.W.
S. Haslam, Esq., Uppingham
Nature, Bedford Street, Covent Garden
Geological Magazine
Jermyn Street Museum
Astronomical Society, Burlington House, W.
Linnean Society
Geological Society, Burlington House, W.
Radcliffe Observer, Oxford
Oxford Union
Cambridge Union
*King Edward's School, Birmingham
*Clifton College N.H.S.
*Marlborough " "
*Wellington " "
*Cheltenham " "
*Winchester " "
Watford "
*Warwickshire " the Museum, Warwick
Northampton Nat. Soc., 26, Langham Place, Northampton
Leicester Philosophical Society
*Birmingham Society
*Bristol Naturalists' Society, Museum, Queen's Road, Bristol
College, Wellington, New Zealand
U.S. Geological and Geographical Survey of Territories, Washington
*Journal of N.H. Societies in Friends' Schools, (York)

LIST OF PERIODICALS TAKEN BY THE SOCIETY,

And kept in the Society's Room.

Land and Water
The English Mechanic and World of Science
The Journal of Botany
The Entomologist
Nature
Science Gossip is kindly placed in the Society's Room by Rev. T. N. Hutchinson

LIST OF PAPERS.

Those marked * are by Members of the School.

REPORTS.

MINUTES OF MEETINGS.

MEETING HELD FEB 10. (46 present.)

Exhibition: Portion of original Atlantic Cable, after being 15 years under the sea, by Mr. Wilson.

Donation: Copy of a paper on '*Drops*,' read before the Royal Society, by A. M. Worthington (O.R.); being a completer investigation of a subject first examined at Rugby, by H. F. Newall.

The President announced the proposed formation of an United Midland Society, which we were invited to join.

Papers: Mr. A. P. Smith read an interesting paper on '*The Art of Printing*,' tracing its history from its infancy to the present day, when a thousand feet of paper in one piece is converted into the *Times* by the Walter press in one minute.

Mr. Bloxam exhibited some valuable curiosities, among which was a piece of the "Royal George."

MEETING HELD FEB. 24. (72 present.)

The President announced that the United States Geological and Geographical Survey of the Territory had offered to exchange their valuable publications for our Reports, and that he had answered, explaining the exact nature of the Society, and pointing out that the exchange would be unequal. (The Survey have since fulfilled their offer with the most lavish munificence.)

A letter was read from M. J. Michael (c), accompanying a present of Depressariæ, and giving some useful hints about thatch-beating.

Several sectional reports of 1876 were read, which have already appeared.*

Mr. Bloxam, amid other curiosities, exhibited some old helmets, including one found in the Tigris by an Old Rugbeian, and supposed to have belonged to one of the 10,000 Greeks of Xenophon's army. The President remembered this helmet appearing in Big School on its way from the station to Mr. Bloxam's when he was a boy in the Fifth.

MEETING HELD MARCH 17. (81 present.)

The President announced that he had received a letter from Wellington College, New Zealand, promising a collection of local Flora.

Exhibitions: Crocodilus Toliapicus, and Avicula Inæquivalvis Junior. Cast of a Dodo's head, by Mr. Bloxam.

Papers: M. Adam read a paper on '*Animals.*' L. Leverson followed with this paper on '*Pearls,*' illustrated by some beautiful specimens.

'Pearls are found in the oyster, both in the fish itself and adherent to the shell. They are produced by a secretion of the mollusc around some object of foreign origin. It is supposed that when the oyster opens its shells some foreign substance may have entered and settled either upon the fish or under it, and to counteract the irritation that the presence of this substance causes, it surrounds it with a secretion that becomes a pearl. This secretion is constantly increasing, which produces small or large pearls according to the length of time the foreign substance has resided in the oyster. A proof of this is found in the fact that the pearl is composed of layers like the trunk of a tree. Pearls are found in all oysters, but those only on the Pacific coast of Central America, the Persian Gulf, the coast of Ceylon, and the coasts of Australia are of any beauty.

'The pearls of Ceylon and the Persian Gulf are the most beautiful in lustre and shape. They generally possess a slightly yellow tinge, while those on the coasts of Central America and Australia are generally whiter but less brilliant in lustre. There are also specimens of various colours, such as deep yellow, brown, black, pink. They are of various shapes, round, half round, pear shape, and of irregular shapes.

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* Copies of the Society's Report for 1876 may still be had on application to the President, price 1s. 6d.

'Pearls are also found in the conchifera of rivers, but they have not generally the lustre of the above-mentioned oyster pearls, although a few very fine specimens are occasionally met with. The shell exhibited has a pearl formed upon it, which has been produced by the oyster to protect itself against the attacks of some mollusc, which you will perceive has bored a hole through the outside of the shell; the remains of such a mollusc can be seen in another cavity towards the edge of the shell. This accounts for the pearl on this shell being hollow; they are very often solid, even when adherent to the shell. In such cases some foreign substance has found its way into the interior of the oyster and lain on the shell as mentioned at the beginning of this paper.'

H. F. Wilson then read the following paper on '*Local Names.*'

'The following paper has been written at the suggestion of the President, who thought it might prove an interesting subject to go into. If it does not prove so to the Society, my very small previous knowledge of it must be my excuse. I must also apologise to Mr. Bloxam for venturing to speak about anything relating to antiquity while he is present: but I hope that he will be kind enough to excuse me and set me straight if I go wrong, as I most probably shall. And though I have written this paper without his assistance, I shall ask him to be so good as to help me if I continue the subject. Before I go on it may be as well to say a few words upon the significance of local names, and here I cannot do better than read an extract from the first chapter of a book called Words and Places, which has been extremely useful to me, and which is here very much to the point. The writer says, "Local names, whether they belong to provinces, cities, and villages, or are the designations of rivers and mountains, are never mere arbitrary sounds devoid of meaning. They may be always regarded as records of the past, inviting and rewarding a careful historical interpretation. In many instances the original import of such names has faded away, or has become disguised through the lapse of ages; nevertheless, the primeval meaning may be recoverable. And whenever it is recovered we have gained a symbol fraught with instruction; for it may indicate emigrations—immigrations—the mingling of races by war and conquest, or by the peaceful processes of commerce: the name of a district or a town may speak to us of events which written history has failed to commemorate." He then goes on to explain the different things that may be learnt from names: some are descriptive, some geological; some give us facts upon history; some illustrate the civilization or religion of past times. Such being the value of the information given by the names of places, which one mentions day after day, without giving a thought to the facts that may underlie them, I propose to take a few of the names about Rugby and consider their meaning. None are so well known, I suppose, as those of the places which we visit every now and then when we go on house-

runs, and being so well-known they will best serve to illustrate my meaning. To begin with, I must say that names are usually made up of two elements, one of which is general and the other descriptive. The general part of the word is usually its termination, as in names ending in 'ton,' or 'ham.' These terminations being quite general, are of course shared by many places. Besides these endings, names have the descriptive element, which may have very various meanings. A simple example is to be found in the word Northumberland; in this word the termination 'land' is the general element, and the descriptive part comes first, telling us that this 'land' lies 'north of the Humber.' With this short explanation I may proceed. We will take the word 'Rugby' first. By some this name is interpreted to mean the 'camp' by the 'quarry,' from the two words 'roche,' a rock, and 'bury,' the same as the German 'burg,' a fort. Perhaps a more likely one is as follows. Remembering that the Watling Street, a well-known road near Rugby, was the great frontier line between the Danes and Saxons, it is very likely that the Danes had some outposts over the border; and so we are naturally led to look for anything that may suggest that that was the case. Now 'by' is a well-known Danish termination meaning 'house' or 'home,' and what more likely that Rugby, Barby, Willoughby, Ashby and Kilsby, all places not far from the Watling Street, should have been such outposts as we have spoken of. For the first part of the word in Rugby, it has been suggested to be from Ruc, which means 'water' in Celtic. Several of the names round here end in 'ton,' meaning 'town,' a well-known Saxon ending. Such are Bilton, Thurlaston, and Hillmorton. For the first of these I have no further explanation, but Thurlaston, which appears in Domesday as Torlavestone, is evidently the ancient home of some old warrior of the name of Torlav, a name which has a very nice northern sound about it. Hillmorton and Lowmorton take their names obviously from their position; the 'more' part of the word meaning simply 'moor,' or 'marsh;' which agrees very well with the character of the soil near the churchyard. Lawford is called in Domesday Book Littleford, which is a contraction for Little Lawford. In this word the 'ford' is obvious, and 'law' means a rising ground. Churchover means the Church on the bank; 'over' being the same as the word 'ufer' in German, which has that meaning. The same is seen in Brownsover. This place is called 'waure' in Domesday Book, being the nearest the people of that day could get to the right spelling of 'over,' and the 'Brown' part of the name, which sounds at first somewhat commonplace, becomes at once aristocratic when we learn that a Norman knight called 'Bruno' held lands there. Shawell means, I believe, the 'well' by the 'wood,' 'shaw' being a word now in use in some localities for a wood; but I believe there is now neither a well nor a wood in the place. Crick, they say, is the same word which appears as Craig in Scotland and Carrick in Ireland, and means a 'rock' or in fact a 'crag.' This does not seem quite to suit the

place, unless the gentleman who gave the name was referring to the hill through which the tunnel goes. Willoughby I have referred to elsewhere as a Danish name most probably; but what the 'willough' part is, if not the tree of that name, I can't say. Perhaps it is this, on the analogy of Ashby. Dunchurch is nothing but Dane-church, and helps out the theory of Rugby being of Danish origin. The whole of the high level between Bilton and the Dunchurch Avenue is Dunsmoor or Danesmoor, and the great Dun Cow itself is believed by some to be a mere corruption of 'Dena Gau,' the 'Danish settlement,' over which Guy of Warwick triumphed several years ago. Wolscote is perhaps Woldscote, *i.e.* the 'mudhut on the wold,' for such is the meaning of 'cote' originally, surviving now in 'sheep-cote,' and 'dove-cote.' For this name turned the other way compare the Cotswold hills in Gloucestershire. The plural of this word is 'Coton,' which gives us the name of another run in the neighbourhood, the familiar name of Coton House, but the derivation hardly applies to the present building.'

Mr. Bloxam exhibited some buff coats from Tamworth and Naseby. He also made some remarks of interest upon the neighbouring places, recalling incidents of the Civil Wars.

The Rev. T. N. Hutchinson exhibited a series of Fluorescent liquids, most of them prepared in the Laboratory. The property of these liquids is to appear of different colours, according as they are seen by reflected or transmitted light.

MEETING HELD MAY 5. (42 present.)

Exhibitions: A fine series of local and Cambridgeshire fossils, by T. B. Oldham. A second paper on '*Drops*,' by Mr. Worthington.

Papers: On Sir John Lubbock's researches into the relation of '*Plants and Insects*.'

'Sir J. Lubbock lately read a paper before the Society of Arts containing facts bearing on the mutual relations of plants and insects which may be an addition to the store accumulated by our two sections, Botanical and Entomological, and if not, are undoubtedly interesting to the public at large.

'They divide into two parts—those showing how Plants are influenced by Insects, and those showing how Insects are affected by Plants.

'Plants are influenced by the love and the fear of Insects. Their love is shown by their bright colours and wide opening in the daylight for bees, or in the night-time for moths, and as one would

think by the honey within their hearts. But one reason that botanists were slow in discovering the use of honey, is that certain plants develope it on other parts of them besides the cup of the flower, where insects are wanted. The fact is that *all* insects are not welcome there. Ants may be very civilized and intelligent creatures, but they are not as good at fertilizing as bees and winged insects are, because they are too short to step on the stigmas and pistils and stamens of any but very flat flowers, and also they have not the bees' power of going from one plant to another at a distance quickly, and so bringing in all the beauty of cross-fertilization. In one case they are accused by Sir John of an extraordinary piece of mischief, which I leave to their advocate to-night to explain to our confused minds. There is a plant, an acacia, in S. America, which is subject to the attacks of certain ants who cut off its leaves—not to eat, but (mysteriously) to *grow mushrooms upon*. Do ants grow mushrooms really? Now this plant has honey all over it, in little bags of sweetness at the end of the leaves; also hollow thorns. The latter are the lodging, the former the food, of a tribe of useful small ants who swarm all over it, and keep off the vegetable-garden owners. Mr. Belt observed this, and he thinks also that the presence of ants prevents herbivorous animals from grazing on the acacia.

'Delpino (was he a herbivorous animal?) mentions that on one occasion he was gathering a flower of Clerodendron fragans when he was suddenly attacked by a whole army of ants. Did they want to eat *him?* Their great use is in eating down small insects and caterpillars which nibble English plants: a nest in a meadow brings in about 28 head of game a minute. Aphis and coccus come round them by secreting sweet juice and letting the ants suck them, and there the defence fails: but on the whole, on the leaves of plants ants are not in the way, only in the flowers, which accordingly arm themselves in various ways against attacks from below, having no honey to spare for stupid friends who crawl. Kerner has investigated and published a description of these means of defence. They consist of chevaux de frises, viscous surfaces, and slippery surfaces. The scabious has downward pointing hairs on its stalk, and the blue cornflower's centre is rough with recurved teeth. Polygonum amphibium has a smooth stem when it grows in the water, but on land it is covered with short hairs ending in sticky glands which no insect dares walk upon. Pendulous flowers are protected by their smooth necks, dangerous for pedestrians.

'Finally, I will notice one simple means of outwitting and baffling the innocent ants, adopted by Lapsana communis and Crepris pulchra, which are open from 6 a.m. to about 10, and then shut: thus getting the bees and escaping the ants who never come out till the dew is off the grass. Early closing like this is very hard on a community disposed to deal with its drunkards by dropping them into the water for dead. Altogether ants seem to have a poor chance of satisfying their souls with honey, and it would be high

injustice to expect them to modify themselves to suit the flowers. But other insects do this, which brings me to the second part of my subject, viz., the influence of Plants on Insects, or how Insects are affected by Plants. The butterfly's legs and the bee's nose have been adapted, as everyone knows, to get at the honey and to carry the pollen. This is a mutual aid society arrangement. The only thing a bee fears is hunger. But a caterpillar fears birds, and yet must eat. To him it is useful to resemble a stick, a leaf rolled up, a fungus; and Sir John has pursued the reasoning suggested by such similitudes, and gives us the life-course of a caterpillar in all his glory of five successive skins. He is a member of the Sphinx family, and is an Elephant Hawk, and is either green or brown, most probably the latter, with long lines down his person and eye-like spots on his last segment. These insignia are acquired gradually. He is born green: after the 1st moult the long lines appear on stomach and sides, and the spots appear dimly: after the 2nd the lines disappear, the spots go on plainer: the 3rd brings him to a choice between brown and green, and he changes once more to become his perfect self with (1) ground colour, (2) longitudinal lines, (3) diagonal lines, (4) eye-spots. The colour is visibly a protection. Almost all young caterpillars are green, but as they swell their outlines spoil the delusion, and whitish stripes break up the surface and are a great help to concealment. Our elephant is a night-feeder and comes down to hide on the ground by day. His brown is the colour of the ground, and if he stays green he had better remain under a leaf. So do some of the Sphingidæ. The greater number of adult caterpillars with long lines live on grass, and hardly any with diagonals do so. The Satyridæ are all grass feeders, and from being streaked in the same direction as the lines and shadows around them are very well hid. But the Purple emperor, Privet hawk, and Kentish glory live on large-leaved plants. They have cross lines, set on at about the angle of the ribs of leaves, but not till they are adult, or the ribs would come too near together for nature. Our elephant has lines both ways, but the lengthway ones were of use to him long before the crossways, and faded out on certain segments to make way for these, because no crossbars are seen among foliage, but angles more or less acute or obtuse. Privet hawk has a lilac stripe. His seat is on the underside of a leaf with the light shining through: his is the exact colour for the shadow of yellow-green. Smerinthus ocellatus, Sm. populi, and Sm. tiliæ are green, and remain under leaves, while four kinds of Chœrocampa turn brown and go down to the ground. The Geometridæ turn brown and stay upstairs: these assume attitudes and look like dead twigs.

'Eye-spots resemble the markings on dead leaves. Deilephila hippophae feeds on sea buckthorn with red berries: he has a red spot on each side. Chœrocampa tersa has spots very like the flowers of the shrub it feeds on. White spots may be taken for the dappling light through leaves.

'Many conspicuously-spotted caterpillars are bad tasting for birds: they protect themselves by prominence. A smallish nasty caterpillar is liable to be swallowed by mistake, unless he sets up hairs or bright colours. The elephant is however quite good to eat: it may be that his spots are intended to alarm foes: they look uncanny. Weissman put a hawk caterpillar in a tray of seeds which he offered daily to small birds: presently a sparrow came, saw the beast, and stood bobbing her head up and down at it without going near the seeds; ten or more came and joined her, but they got no bolder, and one who lit in the middle of the tray, when she beheld the caterpillar, flew off in a great fright.

'It is very instructive to consider the colours and markings of caterpillars as showing us the slow development of the species. Every individual now in a few weeks goes through the same stages which it took ages for his tribe to accomplish. The baby larva is an ancient form. One of the Chœrocampæ, porcellus, is born with a stripe, and is in advance of his tribe; Ch. elpenor is born plain green and passes through four or five stages; but Ch. myron and chœrilus never get to the eye-spots at all. The Deilephilæ exemplify this well.

'There are five principal types of colouring. (1) live inside wood or under leaves or underground, and are of a uniform pale line; (2) are green, like the small leaf-eaters. (3), (4) and (5) may be compared to three types of cats, the sandy, the spotted, the striped. Ground cats are brownish, as the puma and the lion; the leopard lives among trees, the tiger among grass, and he carries his stripes to the same purpose as the caterpillar, who walks horizontally instead of clinging perpendicularly, and so needs his stripes down his sides instead of from head to tail. With this admirable comparison Lubbock concludes, and leaves us to justify it and his other remarks by our own experience.'

Mr. Bloxam gave some accounts of ancient keys and coins.

MEETING HELD MAY 19. (42 present.)

Exhibitions: Nightjar's egg, by H. T. Mills. Fossils from lime and Ichthyosaurus bones from Victoria Works, by Mr. Wilson.

Papers: On a '*Botanical Expedition to Coombe*,' by R. C. Cordiner. On a '*Geological Expedition to Mancetter*,' by G. Jones.

Mr. Bloxam made some remarks upon Roman Camps in the neighbourhood.

The President read the following paper on '*Dasychira Pudibunda*.'

'The larvae came out about Saturday, March 24, and were examined with a small microscope on Sunday, the 1st of April. They are pale yellowish green, with no trace of black between the segments: they have on the segments, after the first three, four small brownish warts, from which proceed two black hairs, each as long as the whole body of the larva, and also a larger number of smaller white hairs. Close to the head and on each side of it lie two little similar warts, rather darker if anything, from which proceed almost a tuft of black hairs. There is no trace of anything like a tuft or tussock of hairs, except the very slight approach to it which these little warts as I have called them supply. It should be mentioned that on the last segment the black hairs are rather more thick than on the others. It is probable that the larva which I examined is in its second skin: though as yet I have no distinct evidence on this head.

'I have also examined a larva of this insect which looked smaller than the one mentioned above, and which I took to be certainly in its first skin. It only differed from the other one described above by being more indistinct in its markings. The colour was like the other, pale yellowish green, but the warts, as described in the other case, were fainter and smaller than in the other. It is to be noticed that the head of the full-grown larva is green, like the rest of the beast: while in the young animal the head is brownish. At first sight this looks like a departure from the regular law that differentiations take place in the later stages only. But really the green head is itself a differentiation: for the normal larva has a brownish head. It is only when full-grown that it is of importance to it not to have a head at variance with its rest.

'April 14, 1877.—I have again examined the larvae of Dasychira Pudibunda, which are clearly in the next stage, having cast their skin once more. Now there is scarcely any trace of the green colour, the tint being pale yellow, with perhaps a faint touch of green. The chief differences are these. The warts from which the hairs proceed are all pale yellow, the same colour as the rest of the larva. The warts are most distinct on the two segments between the real legs and the pro-legs. And between these two segments there is a very clear black patch: this is the most marked detail of the colouring. There are two blackish lines along the edge of the back from the head to the last segment but two. This is blackest at the tail end. From each wart there appear to be about six hairs proceeding, all black and about the same length as the body. From the sides just above the legs proceed other hairs much shorter than the black ones, and white in colour. The black lines in front are smudged inwards, so as to present the general appearance of being grey: behind, over the pro-legs, they are doubled, so as to be in reality four lines. On the last segment but one there is a very small but distinct tussock, the first indication of such a formation. This tussock springs from a wart in the centre of the back. It is faintly reddish. The warts on each side of the

head are very prominent, and are the only ones which still have a touch of black upon them. It is very difficult to count the warts, but there appear to me to be about five lines of them: viz. one line down the centre, of which the most remarkable one is the one which bears the tussock: two on the edge of the back:—these three bearing black hairs: and two above the legs, bearing white hairs. The general aspect of the larva at this stage is all pimply: and from the pimples seem to come all the hairs whether white or black. The head is lighter than in the last stage, being yellowish reddish brown, but yellow much the most preponderant colour. The ordinary attitude of the larva is with the fifth and sixth segments, and the tussocked segment much humped up: especially the tussocked one, which is perhaps really a hump. As the fifth and sixth segments are thrust up, the black patch which lies between them is brought into great prominence.

'I have fed them on rose and hawthorn: of which they apparently prefer the rose.

'May 1.—I have examined these larvae again to-day, and the changes are the following: on the two segments between the real legs and the pro-legs where, on April 14, the warts were most distinct, there are now two distinct yellow tussocks of hair, one on each. Also on the segment which is the last but one, the tussock which on April 14 was just faintly beginning is now the most prominent characteristic of the animal. It is long too, about twice as long as the yellow tussocks, and longer than the pro-legs. The underside of the larva is also now very distinctly black: I did not notice what it was before. The black hairs occupy about the same position as before and about the same prominence. But there are now distinctly visible white hairs all over the upper surface of the larva, which before were not so. These are very short, about the same length as those below. The black patch between the two forward tussocked segments is still more distinct than before, being a very prominent marking. The black markings on the back are more clearly black than before. The wart arrangement seems to continue as before, and where there are tussocks, they come from warts.

'May 5.—Since the last date the larvae have grown considerably, and it is now possible to pronounce with greater certainty upon the gradual change of wart-formation into tussock-formation. The tussocks lie upon the two segments between the legs and pro-legs: and on the upper surface of the larva there are on each segment four warts growing in a transverse line. The warts from the first had hairs upon them, though at first only the long black hairs were visible, two on each wart: then by degrees there came into view smaller white hairs, which seemed at first to exist only on the lower warts, but perhaps were on all. After each change there are more hairs on each wart, and many more on some: and on the two centre warts of the four above-mentioned the hairs grow sufficiently thick to make a veritable tussock. The hairs from the two warts lean towards each other, and so look like one tussock.

'I should add that the dark lines or shade under the body of the beast gets less dark when the larva grows older. It is as yet a good deal less dark than it will be when the larva is full grown.

'May 17.—The larvae are now in their next skin, and I proceed to describe the changes that have taken place.

'The black mark is still more prominent between segments 4 and 5. But there are also faint signs of it between segments 5 and 6. The markings on the back are very much the same as before: only they seem to have a tendency to disappear as the larva approaches the end of the period before the next skin. This is very difficult to account for: as I do not think it is delusive, and only occasioned by the growth of the whole body, so that the markings remaining the same only occupy a less proportion of the whole. This theory is not confirmed by a close inspection.

'In this stage there are also signs of tussocks on two more segments, viz. 6 and 7. Indeed the tussocks on those segments seem very clearly marked, though not so large as the previous ones. On segment 8 the hairs are thicker than elsewhere: and so we have a regular series shading off from hairy warts to regular tussocks. The under side is dark, as before, but not yet quite black. On one wart I was able to count five long black hairs and about thirty shorter white ones.

'May 21.—Four new larvae out of their skins. The first thing that strikes one is that the general colour is much altered: the yellow is much less, and the general appearance is far more grey. The tussock is grey: and the tail red tussock is at most a very faint reddish grey: while in the last skin and before it was a brilliant red. The black space between the segments has extended to three segments, and is exceedingly well marked, viz., 4, 5, and 6.

'Another change is in respect of the warts: they are in the same position as before, but the hairs on them are very different: the black hairs are so much shorter, being scarcely if anything longer than the white ones. There are still, as far as I can count, about six or seven black hairs to a wart: but the white ones have increased in number. The result of the shortening of the white hairs is to make the general colour of the larva more grey, as I said.

'I notice another thing: that in the larva just before this change the segments where the new tussocks are to spring from are apparently very tight, as if there was pressure below them, as is very likely the case.

'Three of the new larvae are much darker than the fourth: these no one would describe as being yellow. He would say they were brown, with a touch of yellow dotted about them.

'May 26.—All out now, and the general result is that they are very much greyer,—indeed remarkably so. The black marking is so general as practically to equal the yellow, if not more.

'I have been enabled to count the warts at last; they are eight on each segment, arranged in a line at right angles to the axis of the insect. And it is clear that there are no hairs except such as

proceed from these warts, the rest of the skin being velvety in appearance. On the last segment before the one from which proceeds the tail tussock there is, in the insect which I examined, a peculiar appearance: a kind of shiny pimple, something like one of the warts, but with no hairs on it.

'One observation more. I stated that the tussock was sprung from two warts, the hairs of which leaned together, so as to make one brush. I noticed however one larva whose tussock when he was very much curled up divided into four, transversely as well as longitudinally: so that there are not only two lines of warts down the back, but also the warts probably run in pairs on each segment.

'The question may arise when the skin changes whether the new hairs come out of the old ones, being drawn out of them as out of a sheath, or are packed flat under the old skin. I have no direct evidence of this, which, indeed, would be rather difficult to get; but from two reasons I should think that the hairs are not drawn out of the old ones: viz. 1, there are more hairs each time the skin is changed than there are before, so that many hairs would have to come out of one, which is unlikely: and 2, when first the larva has cast its skin, the hairs look dampish and curly, as if they had just come out from under the old skin.'

MEETING HELD JUNE 2. (32 present.)

Exhibitions: A young alligator escaping from the egg, by Mr. Wilson. A red-backed shrike's egg. Singular growths of boughs, by Mr. Cumming. Fossil Mammoth Ivory, by T. B. Oldham. A carefully compiled list of Rugby fossils, by the same.

'*Papers:* On the '*Pastimes of a Horse and a Sheep.*'

'I think it may perhaps be of some interest to you to hear of the following proceedings of a horse, of which I myself was a witness. Last Sunday evening, on returning from a walk to Caldecott's Spinney, in passing a field I saw some people looking at something in the field, and on looking myself in their direction, I found out that they were watching a horse, playing (if I may give it that term) with some sheep. I watched it attentively, and was much amused to see it catch hold of one of the sheep with its mouth: it then shook it, and seemed to try to carry it. At this moment some boys jumped over the railings and frightened it away; but it was no use, for as soon as they had gone it again made a trot towards them, and to my surprise picked out the same sheep again, and proceeded with its game in precisely the same manner as it had done before. Presently however it seemed tired and let go its hold, much apparently to the sheep's relief; but the moment the sheep expressed a wish to be off, the horse seized it and dragged it

back again. It was then again frightened by the boys, but nevertheless seemed determined to renew its sport, and gave chase to it again; and at last, to my surprise, the sheep suddenly stopped, and the horse stepped over it without doing it any harm; the sheep then appeared not to mind, and kept rubbing itself against the horse's legs. I thought this might be worth mentioning.'

Mr. Seabroke mentioned the case of a horse which was in the habit of pulling off sheep's wool.

On the '*Phylloxera*,' by an anonymous contributor.

'There is an insect of this name infesting the vineyards of France, which is so remarkable that it is worthy of notice in itself, as well as for the mischief it does. Since the year 1864 much has been written on the subject of the mischief, its causes and cures; but only in February of this year is published in the *Revue des Deux Mondes* the result of the investigations of several scientific men into the "Manners of the Phylloxera," which are indeed the worst manners imaginable for the vines. All over the claret country the shoots come up green and healthy, and then before long are drooping, gnawed at the roots by a thousand phylloxeras.

'They were introduced into Europe from the United States, on the roots of vines transplanted across the Atlantic. Cuttings had long been imported without harm ensuing; the insects either were not on the leaves, or were comparatively harmless there; but in 1862, for some reason, bundles of roots were landed simultaneously in different parts of the country, set, and infected their whole neighbourhood so rapidly that the evil was speedily discovered; but not combated, as should have been—for the French peasant is superstitious and unenterprising, and consoled himself with hopes that the vines would recover.

'The life of a phylloxera, if now considered, proves the futility of mere hope, without means. This is the account given in the *Revue* of the observed facts. There are no less than three forms of the phylloxera.

'"The one most universally spread has *no wings*, and lives underground. It is multiplied by parthenogenesis, which means that all are females and lay eggs. Five or six generations of these succeed each other in the course of a year, and the observations of M. Schrader of Bordeaux, and of M. Lichtenstein, have shown that this independent multiplication can continue for at least three successive years, the last generation of the autumn hibernating and waking again in time to give birth to the first generation of the summer.

'"However, from June and July onwards, and sometimes as late as November, appear among the wingless parents certain caterpillars with narrower waists, who soon pass into chrysalises, and finally are transformed into elegant little flies with four transparent wings. This is the *winged* form of the phylloxera. From

the eggs laid by each fly under the leaves, or upon the buds of the vine, come forthwith the most singular beings, smaller even than the young wingless ones down at the roots—not only wingless, but destitute of mouth or stomach,—in fact, nothing but egg-makers, male and female; so that these constitute the *sexual* form of the phylloxera.

'"The female lays her one egg under the bark of the vine-stem, and dies beside it. Very differently from the underground unfertilized egg of the wingless insect, this solitary egg beneath the bark does not hatch till the following spring. For this reason it is called the winter egg. During the month of April, in the climate of Bordeaux, the young phylloxeras just come out of the winter egg get at the young leaves of the vine, and begin to make on their surface, by punctures, vesicular galls around themselves. Some however finding a difficulty in puncturing the leaf, renounce their existence in the upper air, and take their way down the shoots and stock of the vine to the roots, where it is supposed they head a line of underground descendants. This is also done sooner or later, in any case before autumn, by the gall-inhabiting phylloxeras, who survive several generations upon the same vine-shoot, but for unknown reasons are able to emigrate from the leaves towards the roots. In any case, at whatever moment in the year the migration takes place, it is admitted that the gall-phylloxeras are transformed into root-phylloxeras, and these in their turn, emerging from the soil in the winged state and passing through the sexual form and the winter egg, become phylloxeras of the gall.

'"Thus is formed a complete cycle in the manifold life of the species, which comprises all its phases of evolution and all its adaptations to circumstances of food and surrounding. It is only upon the duration of these phases, and the possibility of an insect's passing over an intermediate stage, that all are not agreed."

'Such are the "mœurs de phylloxère:" and now for the remedies to be applied to them. The peasants tried burying a live toad, and watering with white wine; but both these applications proving vain, they wisely appealed to wise men. After many experiments it is pretty clear that though much may be done to keep them in check, yet to eradicate them is impossible so long as the vines live to nourish them. But it is found that different sorts of vine have very different powers of bearing up under their attacks. In fact, America is to supply the cure for the disease she has imported. The native American vine is beset with phylloxeras, but thrives in spite of it: even the most susceptible of the American species stands it better than the strongest European. The manifest conclusion of M. Plauchet, writer of this article, is—Plant all *infected* districts of France with American vines; only, as these are full of the pest, avoid going near any healthy vineyard. The present state of things is this—1st, Burgundy is hoping to defend herself from the first onset of the creatures, by sacrificing whole districts where they have appeared. Bordelais is deeply infected, but hates the

thought of exotic vines, and hopes much from the destruction of the winter egg. The South, more disciplined, is trying to graft its native shoots upon the roots of the United States, and hopes to discover new elements of excellence in this way.

'The cure of the sick plants is not despaired of. Sometimes, when a vine is in the last stage of consumption, the murderers find their food insufficient and desert it in a body; some such cases have recovered. Altogether M. Plauchon advises patient trial of all methods in different places, without delay, or the poor inhabitants of a great part of France will be brought to ruin and desolation.'

Mr. Wilson remarked that the Aphis and some Medusæ passed through similar alternate generations. Speaking of the fertility of the former insect, he observed that it could produce 400,000,000,000,000 of its kind in a year.

Mr. Hutchinson exhibited a large number of his own drawings of caves and scars in Yorkshire.

H. St. J. Bashall read a paper on '*An Expedition to Princethorpe.*'

Mr. Bloxam exhibited some ancient curiosities.

Mr. Percy Smith read the following paper on '*Balloons.*'

After describing the early dreams of aerial navigation, Montgolfier's first hot-air balloon at Avignon, Nov., 1782, and Charles' first hydrogen balloon at Paris, 26 Aug., 1783, the writer proceeds—

'In the year 1783 many experiments were made both with Charlière and Montgolfière balloons. Animals were even sent aloft and descended again safely.

'These experiments, and others which it would be useless to enumerate, having shown that such aërostatic machines were capable of carrying up great weights, and consequently men, with safety, Pilatre de Rozier offered himself as the first aërial adventurer, and ascended on Oct. 15th, 1783, in a Montgolfière balloon 48 feet in diameter and 74 in height, a proper gallery and grate enabled the aëronaut to supply the fire with fuel. The entire weight was 1600 lbs. Rozier first ascended to a height of 84 feet and descended gently. He then rose to 210 feet, and a third time to 262 feet. In his third descent the wind blew him towards some trees, but by throwing more fuel on the fire he was able to rise sufficiently to extricate himself from this difficulty, and reached the ground in perfect safety.

'On the 21st Nov., Pilatre made another ascent with the Marquis d'Arlandes and journeyed about 5 miles.

'This last voyage may be said to conclude the history of Montgolfière balloons, which were found inconvenient on account of the impossibility of keeping up the temperature of the enclosed

air without the continued renewal of fuel, and the inability to command that uniformity of rarefaction necessary to the safety of the voyage.

'The first aërial voyage in a hydrogen balloon was made by Charles and Robert on Dec. 1st, 1783, at 1.45 in the afternoon. The balloon was $27\frac{1}{2}$ feet in diameter, and was provided with a valve by means of which they could let out gas when necessary. They ascended to a height of 900 feet, deduced from the fall of mercury in a barometer. A N.N.W. breeze carried them across the Seine, and over several towns and villages, to the great astonishment of the inhabitants. After a voyage of $1\frac{3}{4}$ hours, they descended near Nesle, 27 miles from Paris, having travelled at the rate of 15 miles per hour. The success of these experiments spread a universal enthusiasm throughout Europe.

'The first exhibition of a balloon in England was made by Count Zambecari on Nov. 25th, 1783, who sent up a hydrogen balloon 10 feet in diameter, and the first aërial voyage was performed by Signor Lunardi in a balloon 33 feet in diameter on Sept. 15th, 1784. He ascended from the artillery ground in London, taking with him a dog, a cat, and a pigeon, and descended after a journey of 2 hrs. 10 min., at Standon, near Ware in Hertfordshire.

'On the 13th Jan., 1784, a balloon 37 feet high was launched from the Castle of Pisançon, near Romons in Dauphiné. It rose with great velocity in a S. direction, but when it had ascended to a height of 1300 feet, it went towards the N. It ascended to a height of 6000 feet in less than 5 min. from its departure, and fell 4 miles off.

'This experiment gave the first indication of contrary air currents existing in the atmosphere. Blanchard, Seldon, and Sadler, also ascended in England about this time; and a most remarkable journey was performed on the 7th of Jan. 1785, by Blanchard and Dr. Jeffries, in which they crossed the English Channel. The balloon was placed with the car resting on the edge of the cliff at Dover Castle. At one o'clock the balloon was launched, but being insufficient to carry its load, they were obliged to throw out all their ballast except three bags of sand, weighing 10 lbs. each. They then rose gently, and had a beautiful prospect of the south coast of England, along which they could count 27 villages. At 10 min. to 2 they found themselves descending, and threw out the rest of their ballast; but this being insufficient, a parcel of books followed, when the balloon rose again. They were then about half way across. At $\frac{1}{4}$ past 2 they began to fall rapidly; and provisions and instruments being sacrificed without avail, they stripped themselves of their clothes, and were even prepared to cut away the car, when they felt themselves ascending; and as they passed over the high land between Cape Blanc and Paris, the balloon rose very fast and finally deposited them among some trees in the Forest of Guiennes, where there was just sufficient opening to admit them.

'In consequence of this voyage, the king of France presented M. Blanchard with a gift of 12,000 livres, and a pension of 1,200 livres a year.'

The writer then describes the invention of parachutes, and the first application of ballooning to scientific purposes. He then continues—

'Coal gas had not long been introduced for illuminating purposes before it was adopted for filling balloons, on account of its more ready production. In France, Barral and Bixio made a scientific ascent with coal gas in 1850; and in England, it was adopted by Glashier, who, with Coxwell, ascended in a balloon containing 90,000 cubic feet of gas, the weight of the load being 600 lbs. The ascent took place on Sept. 5, 1861, at 1 P.M. In 28 min. they reached a height of 15,750 feet, and 21,000 feet in 11 min. more. Temp. 14°. At 1.50 they attained a height of 26,000 ft. Temp. 5°. At 1.52 they reached 29,000 ft. Temp. 3.2°, when Glaisher fainted from the great rarefaction of the air and the intense cold. Coxwell had the end of the valve cord between his teeth, his hands being powerless, and he continued to ascend till upon the point of insensibility, when he pulled the cord and suffered the gas to escape, the barometer standing at 7 inches, corresponding to a height of 36,000 or 37,000 feet, or nearly 7 miles.

'With coal gas, Greene, in 1863, travelled from London to Nassau in 16 hours. Flammarion and Godard, in 1867, travelled from Paris to Solingen, a distance of 260 miles, in 12½ hours. Nadar, who attempted to take photographs whilst in the air, filled his balloon "Le Giant" with 212,000 cubic feet of gas, on his journey from Paris to Hanover, on October 18, 1863, a journey which was attended with some danger. A return to the use of hydrogen has been made by later aëronauts; but during the siege of Paris, when communication with the outer world depended entirely upon balloons and pigeons, necessity compelled the use of coal gas, as being more easily procured. 65 balloons ascended from Paris between Sept. 28, 1870, and Jan. 22, 1871, carrying 91 passengers, 363 pigeons, and 2½ millions of letters, for the most part with success. Only 5 balloons fell into the hands of the Germans. One descended in Munich, another at Wetzlar, one disappeared entirely—probably in the sea, whilst the fragments of another were found clinging to a tree at Port Natal in the autumn of 1873. All the others descended safely beyond the country occupied by the beleaguering armies, or upon neutral territory: one in Belgium, three in Holland, and one upon a snow field in Norway, 220 miles to the N. of Christiana, and 680 from Paris—a distance which had been travelled in 15 hours.'

He next relates the attempts to *steer* the balloon, by making it of a fish-like shape, with a screw turned by steam. The utmost effect attained in steering was on Feb. 1, 1872, when the balloon made an angle of 12° with the direction of the wind. The paper then goes on—

'In order to counteract the effects produced on the human system by the rarefaction of the air, the inhalation of oxygen has been tried with good results, and the fatal effects of that rarefaction were only too strikingly shown on the 15th of April, 1875, when the "Zenith" made an ascent from Paris, in order to determine the quantity of carbonic acid in the atmosphere at a height of 24,000 feet. The ascent took place at 25 minutes to 12. M. Sivel was captain, and Messieurs Gaston, Tissandier, and Croceé-Spinelli were the other passengers. In about an hour and a half they reached a height of 22,800 feet, and the passengers were quite well, but felt weak. Oxygen produced good effects when inhaled. A quantity of ballast was then thrown overboard, when Tissandier fainted. At 18 minutes past 2 he was awakened by Crocée-Spinelli, who told him to throw out more ballast, as the balloon was descending. He obeyed; and at the same time Spinelli threw overboard the aspirator, weighing 80 lbs. Tissandier then wrote a few disconnected words in his note-book, and again relapsed into unconsciousness. In about an hour he regained his senses, and found the balloon falling with terrific rapidity, his two friends black in the face, and the blood flowing from mouth and nose. They were dead.

'The balloon was caught in a hedge, 190 miles s.s.w. from Paris, Tissandier being compelled to tear it open, in order to arrest its course.

'The problem of the possibility of steering balloons has been again attacked by M. Bowdless, who made an experiment at Woolwich on July 25, 1874. His apparatus consisted of fans, like the screw propeller of a ship, 3 ft. in diameter, making 13 revolutions per second, and worked by hand. When the balloon was exactly balanced, the vertical fan caused it to rise and fall, but the horizontal fan had no effect in guiding the direction of motion.

'The solution of the problem is still in abeyance. It is scarcely possible that manual power will be found sufficient for the purpose, but there are no doubt many who are sanguine enough to believe in the fulfilment of the prediction uttered by Erasmus Darwin, the first part of which has already borne fruit.'

MEETING HELD JUNE 16. (40 present.)

Exhibitions: Pottery from Long Lawford, by H. Bashall. Drawing of an abnormal apple tree, by Mr. Cumming.

Papers: H. Weisse read the following on '*Continuous Edges.*' (See plate 6).

'If a plain strip of paper be gummed together at the ends, we find a hoop produced which has two separate edges. If a knife be inserted, and a cut be made right round the hoop, we evidently get two separate, narrow hoops. But if in closing the strip we put a single turn, or twist in the paper, we get a figure which has only one

continuous edge: that is, if we start from any point on the edge and go round it, we find that we have traversed the entire edge of the paper before we come back to the starting point. The accompanying figure may perhaps help to shew what is meant, the edge running in order of the alphabet, from *a* to *a*. .(Plate 6, fig. 1.)

'Having then such a continuous edge, it follows, if we insert a knife at any point such as "*m*" and cut round, we shall cut through "*n*" and come back alongside of *j k l* to "*m*" again. Thus we will cut off a hoop of the breadth *c m* (or *n h*), and twice the circumference ot the original one. It also follows that the new hoop will have two twists and two edges, (the original continuous edge and the new one cut parallel to it). Suppose now that *m* and *n* fall together half way between *c* and *h*; then we cut off half on each side and leave nothing, that is, we cut the ring with one continuous edge, into one with two edges, four twists and half the breadth of the original one. We have now got the ring with four twists. What if we cut it along the middle, as we did the other? It has two edges. Hence if we cut between them, we must get two rings, as if there had been no twist at all. But as the edges were intertwined before, so must the rings be intertwined now; and thus we get two rings, each having four twists and two edges, looped one into the other; which if stretched, shew a figure like this (fig. 2). If each of these rings be again cut, we get 4 rings, each with four twists and having two edges, each ring being looped into every other. If we cut six times, starting with the original single twist, we get 6 of these 4 twisted large rings, which can be arranged into a pattern as shewn in the figure. And so on for any number of cuttings. The best way of illustrating this, is, for every one to do it for himself, as a drawing can scarcely shew it clearly. So much for rings with 1 and 4 twists. We will now go on to ones with 2 and 3 twists.

'First, the general principle must be noticed that every ring with an odd number of twists has one continuous edge, and every one with an even number of twists has two separate edges. Now a ring with two twists has its two edges once interlaced, as this figure (fig. 3) may help to shew; *i.e.*, if we pulled out the edge 1 to 2, it would be linked into the edge 3 and 4. Hence, if we cut round between 1 and 3 and 2 and 4, we cut the rings into two which are linked into together once. If the "two twist" ring is cut into thirds, we get three rings with two twists, each linked together thus. A fourth or fifth ring does not at all extend the figure; it only confuses it by doubling one of the 3 links, as is indicated by the dotted lines in the figure. This result seems natural, as one cannot have more than 3 links, *each* linked into *every* other, forming a closed chain.

'Next, let the original ring have 3 twists. We now find that the paper can be flattened like this (fig. 4): from which it will be easily shewn that the one continuous edge of the ring has an absoluted knot in it, that is, not only have we the twist which causes the edge to be one continuous one, but we have also the two twists extra,

which tend to interlace the edge with itself, so as to form a knot when pulled tight. (The same two twists that before caused the two rings to be looped into one another, when there were two edges). From these observations it follows that if we cut this 3 twist ring, we get one large ring with a knot tied into its circumference. In (fig. 5) I have not attempted to shew any twists in the paper, as they do not come at any fixed places in the ring. There are 12. This figure can be drawn out to form various other patterns. The most easily got at is this (fig. 6), which becomes doubled by cutting the 12 twist ring again, to form a figure with 6 loops, the 3 points of second ring coming to O, P, and Q, and being interlaced into *a*, *b*, *c*, at α, β, and γ.

'The rings with 5, 7, &c. twists, when cut, all form figures like fig. 7, with 5, 7, &c. loops. Those with 4, 6, &c., all form two rings when cut, more or less entwined in each other. The explanations of all the results thus obtained readily follow from what has already been said, so it is needless to say any more about them now.'

On '*Monkeys*,' by N. F. Jenkins. (See plate 5).

'Among the various races of animals, few, if any, exceed the monkey tribe in interest. But from the shy and retired manners of the animals in their wild state, their habits are difficult of observation, and but very few are favoured with the opportunity and time of observing them.

'Cunning, joined with caution, and the faculty of imitation, are the characteristics of the whole tribe. These propensities are increased in a state of confinement. (I am able to speak from experience on that point, as I had two monkeys as pets for some time; one unfortunately died, the faculties of the other were so much increased by confinement, that she was no longer fit to be kept).

'Of all the faculties I have mentioned, none is so great as that of imitation. I have heard of this talent (if it may be called so) even leading to their own destruction. Monkeys are said to have cut their throats in imitation of the feigned action of a person they annoyed, and one monkey is related as having infused a paper of tobacco, instead of tea, into milk and sugar, as he had observed a sick sailor do. How far these stories are true I will not attempt to decide, but still I have seen my own pets exercise imitation to a very great extent.

'Amongst other things they were very fond of tea, and whenever tea was given them in a cup or saucer, instead of bending the head, they would lift it up and drink like a human being.

'One was also very inquisitive. At the same time we had a tortoise living in the house: this the monkey could not make out at all. Its first introduction to the tortoise occurred in the following way. Jinnie, for that was the name she rejoiced in, had had some boiled rice given her: she however saw something more attractive, and left her rice; when she returned, she found the tortoise busy

at her plate, so she made a grab at the tortoise's head, which was quickly withdrawn within its shell; she then lifted it up, or rather tried to do so, but finding her endeavours in vain, she set it down, and watched. Whenever the tortoise endeavoured to go, the monkey attacked it. For how long this would have gone on, I cannot say, but something else before long attracted Jinnie's attention, and poor tortoise was allowed to escape.

'As monkeys so nearly approach men in formation, I think that a few words, giving some of the differences, would not be out of place. I will commence by showing that the legs of the most man-like monkey are entirely unfitted for maintaining an upright attitude, while they are perfectly adapted to perform all the requisites of a life in the woods.

'In man, the legs are equal in length to the head and trunk, while the arms are comparatively short.

'In monkeys, however, the legs are comparatively short, while the upper limbs, or arms, if they may be called so, are very long, so as to allow his knuckles to be applied to the ground when the animal is nearly erect, and that is the general mode of progression.

'I will now turn to the foot. In a man, the whole surface of the tarsus, metatarsus, and toes, rests upon the ground, and the os calcis forms a right angle with the leg.

'In monkeys, this bone forms an acute angle, and does not rest upon the ground. The sole of the foot is narrower, and in all attempts at walking upright the foot has been observed to rest upon its outer edge.

'The most marked peculiarity is the length of the toes, and the position of the great toe, which is placed nearly in a line with the ankle.

'There is one kind of monkey, or rather baboon, that has a still further difference—the tribe I refer to is that of the Siamangs, found in Sumatra: they have the first and second toes closely united. (I have here a rough sketch of the foot, fig. 1).

'The arms more nearly resemble those of a human being, but the hands are more fitted for grasping than for performing anything that requires skill, while their great length shows them to be especially fitted for climbing.

'The face is also very different in monkeys. It is an instrument for the procuring of food, and a weapon for offence and defence. The jaws are narrow and elongated; the chin, lips, cheek, eyebrows, and forehead, are reduced to a size necessary for animal purposes. These are the most marked distinctions between mankind and the monkey race. Perhaps this sketch of a skull will illustrate my meaning, (fig. 2).

'To give a description of every race of monkey would be an impossible task in a short paper like mine, for however brief each description was, it would take a very long time to describe a very few races, so many varieties are there. I will endeavour now to give some description of the ourans, who form no inconsiderable

part of the monkey tribe. These animals approach mankind in their formation more nearly than any other class. They are divided into three classes, Troglodites niger, Pithecus Satyrus, Hylobates (so called from ὑλοβατης).

'The first are inhabitants of Africa; they are covered with long black hair, they live in troups, and are very fierce.

'The second class inhabits Asia, and is chiefly confined to the Islands of Borneo and Sumatra, and the peninsula of Malacca.

'The third class is distinguished by its extreme length of arm.

'Besides the orangs, there are very many classes of smaller kinds; among these, the Douroucouli is worthy of mention (fig. 3). It is an inhabitant of South America; it has a grayish white fur, with a line of brown down the centre of its back: the head is marked with three dark stripes; the general resemblance of its face is more like that of a cat than of a monkey; the eyes are large and of a bright colour. It sleeps during the day, and is averse to light of any kind. It selects shady places, in the hollows of trees, etc. While asleep it sits like a dog: the back is bent, and its four hands brought together; in this state it may be handled freely, without fear of biting. It lives on small birds and insects, and is very fond of flies: it is even sometimes tempted to hunt for them during the day.

'Monkeys being so very like human beings, there is little wonder that they have become objects of superstition. It is related that in the city of Ahmenadab, a hospital was erected in which thousands of monkeys were kept in ease and indulgence. Mofleurs, in his history of India, describes a magnificent temple erected to monkeys: and Linschotten says, that when the Portuguese plundered one of those monkey temples in Ceylon, they found in a gold casket the tooth of an ape kept as a relic. It was held in such veneration by the natives, that they offered 700,000 ducats to redeem it. They seem to have been reverenced by the Egyptians, and are said to have borne a rank equal to that of the sacred ibis. They are represented in sculptures, and their bodies were preserved as mummies.

'Perhaps a few words as to the method of keeping them would not be unappropriate. The simpler the food the better, and it should be of a vegetable nature; let them have plenty of water, and as much freedom as possible. If they have these, they have all the luxuries and pleasures of monkey life.

'It is really wonderful how affectionate they become: they will come when called and perch upon one's shoulder, and follow like a dog; but care must be taken not to enrage them, for then they will show that they have a sharp set of teeth, and what is more, know how to use them.'

On '*Sticklebacks*,' by Swetenham.

R. C. Cordiner read an interesting paper on '*Snakes*,' of which we extract the following.

'The way in which they take a frog is most curious, and certainly gives one the impression that they have power of fascination, although this has been denied. When pursued by a snake, the frog cannot hop away, as you would expect, but crawls languidly along: the snake catches it by the hind leg and gradually swallows it. I have heard of a case of which I cannot give any explanation. A snake swallowed a newt, and put it out again: perhaps the swallowing process was to make the newt easy to swallow, but he did not eat it after all. Besides actually eating their prey, they will sometimes make it bleed and lick the blood off it. I once saw a snake kill a mouse by darting at its throat, and then lick it all over, squeezing it to get the blood, which it licked up: after this it did not eat the mouse. They live also on insects, which they catch with their tongue. They are always putting out this tongue, and it seems probable that they get small insects in this way. It is astonishing how long they can remain without food: these snakes did not eat for five weeks after I had them, and the smaller ones have not eaten yet. I have heard of them being a much longer time than this without food.

'They are perfectly harmless, but are not without a weapon. They have a most disagreeable one, as they can emit from valves under the scales a most offensive smell: so bad is it indeed that it cannot be overpowered by any artificial scent. They do this when angry or frightened, and used to do it a great deal more when I first had them than when they got tamer. When angry, they swell out to nearly twice their ordinary size, and hiss violently; darting at your hand with so much fierceness, that even when you know them, it is almost impossible to keep from withdrawing it.

'They can sustain injuries in really a wonderful manner. One, in getting down a rat hole, was so pinched by the efforts of its owner to get it out, that a piece was taken out of its side, and it was nearly in two, a part of its backbone being broken; in this state it lived for nearly a week, when it died. One of my own snakes met with an accident which would have killed most ordinary creatures. It got loose one day and had a study door slammed upon it. This treatment did not even leave a mark, and it did not appear to suffer any bad effects. The door sprang back as if from a spring, when it came in contact with the snake. They are very hard things to keep from getting away: they can get through the most astonishingly small places, and will hide themselves in almost anything. I lost one of my small ones the other day, and found it in the road nearly a week afterwards.

'I skinned the one which died, and noticed a curious fact about it of which I should be very glad if anyone could give me an explanation. After having skinned the snake, I put its body into quite clear water. After a minute or two, a film gathered over the water, so that you could not see into it; steam rose from the water, and in another minute it disappeared and left the water as clear as before. The same thing occurred a second time, after I had taken the snake out and put it in again.

'Their mode of going along is also curious. I have sometimes seen them going backwards, especially when frightened. Wherever the head goes, and whatever curve it makes, the whole body must follow. I noticed one put its head into my pocket and took it out again. I left it to itself, and found that the whole body down to the tail dipped into the pocket as far as the head had done. Their motions in the water are very graceful; they can swim at a great rate, and can remain under water for as long as 5 minutes together without coming up for air. They have great power in their tails, and can hang from anything by surrounding the object with almost the extreme end of their tail. They cast their skins as often as five times a year, but generally twice in the summer. They get rid of the old skin by crawling through stiff brushwood when the new skin has formed;—I have not yet witnessed this interesting proceeding myself. In their wild state they lie dormant during the winter, often in a hollow tree, many hundreds together.

'Perhaps it will not be out of place here to say a few words about keeping them. I don't think that any pets, (if such animals can be called pets) could give less trouble; their only needs are plenty of light, air, and water. Besides having water in their cage, they should be often allowed a swim in a larger vessel. They should have some grass to crawl about in and clean themselves: any small animals may be given them for food, but frogs are their favourites. Any trouble they give, they amply repay by becoming tame, and knowing those who keep them.

'The males may be distinguished by being brighter and more clearly marked than the females.'

MEETING HELD JULY 15. (33 present.)

Exhibitions: A frog after a week spent inside a snake, and some resurrection moss, by R. C. Cordiner; &c.

Papers: On '*a Monstrosity of Fox-glove* (Purpurea Digitalis),' by V. H. Veley (c).

'I have forwarded this specimen to the Society, that the account of it may be compared with the account of a somewhat similar monstrosity described by the Rev. Charles Smith, (page 18, Report for 1873).

'The inflorescence of the Foxglove is as a rule "indeterminate," *i.e.*, no bud grows at the top of the stalk, and ends the flowering of the plant for the year.

'A short time ago, I observed that at the top of the stalk there was a terminal flower, consisting of 15 petals, 12 stamens, (the proper number if five buds had coalesced together). It is difficult to state accurately the number of sepals, as the bracts and sepals were mixed together. Instead of any stigma developing, the stalk

grew slightly, and petals were developed in whorls round the stem; and this would probably have continued for some time longer. The stamens developed pollen. From what I can see of the drawing of the flower, (on the opposite page to the description of Mr. Smith's monstrosity,) I should say that a stigma developed in that case: but history is silent. On page 19 of the 1873 Report, I see that the monstrosity flowered before the buds below it. I did not find this to be the case. Perhaps the Society would forward this specimen to Mr. Smith, and if it is considered of any interest, it may be preserved in the Society's Botanical Collection.'

On the '*Expedition to Stoneleigh*,' by C. E. Carter (M). The important parts of this paper are embodied in the Entomological Report, *infra*.

On the '*Growth of Woodbine round Sticks*,' illustrated by specimens, by R. C. Cordiner (M).

On a '*Geological Expedition to Stretton-on-Dunsmore*,' by W. Ecroyd, read by S. H. Walrond (A).

On '*Frogs*,' by M. M. Adam (M).

A new Archæological Section was announced, which Mr. Bloxam kindly promised to assist: he also exhibited some curiosities, including a token found in the Close.

MEETING HELD OCTOBER 13. (79 present.)

Exhibitions: A large number of Indian, Chinese, and Japanese curiosities, by W. E. Home: these were presented to the Society. Holiday collection of insects, by W. Willoughby.

Papers: On '*Tripontium*,' by G. Jones (M).

[Subsequent investigations having revealed several additional facts, this paper has not been printed, as the author intends to read another on the subject.]

On '*Cave's Inn Remains*,' by H. St. J. Bashall (M).

'Jones has just described the road to, and the position of Tripontium; I will now describe the remains found there.

'First. There are two pits, one on the same side of the road and above the house, the second on the other side of the road, and opposite to the house.

'The first is on the west, the second on the east of the Watling Street. We found most of the pottery in the first, which I will

now describe. On the surface lies black earth, to the depth of a foot or so. Below this lies sand and gravel, in which is an isolated patch of black earth, about six feet from the surface. Here I found a rib and a piece of pottery. Two or three yards to the west of this is what now appears to be a semicircular recess in the face of the gravel, about eight feet deep. This was originally a round hole, walled round with big pebble stones, and full of black earth. The stones now lie in a heap at the bottom of the pit, and the black earth has gone. No remains of any description were found in it. Mr. Bloxam considers that this was a dust hole, or refuse tank of some sort. The turf has been removed from the top of the black earth over this part, and we found there many remains on the surface.

'In the second pit, the black earth on the surface lies more irregularly, but there are no isolated patches. The field above this pit is ploughed, and literally covered with remains. The black earth is of course of animal origin: it occurs also with Roman pottery at Long Lawford and Princethorpe.

'Secondly, the remains in the pits. (1) The Samian ware is of a red colour, and fine texture. It is glazed. One piece, apparently the stopper of a jar, has an inscription beginning with M on it. (2) Mortaria. These are of coarse, thick, reddish-brown ware, and have projecting rims; their surfaces are covered with lines running regularly round them, as if, when on the potter's wheel, a comb had been applied to their sides. They are usually smoked, as if used for kitchen purposes, and it is noteworthy that they occur mostly in the western pit, where most of the bones were found. (3) The common pottery. This must be divided into (*a*) the fine, and (*b*) the coarse pottery. (*a*). The fine is of a bluish colour, sometimes blackish, with a smooth but unglazed surface, with rims and ornamentations, of which some are little rims on the side, and some marks as of the potter's mail. (*b*). The coarse is red, bluish, yellow, brown, black, of various thickness, and rough surface. We also found pieces of brick, but these are rare. Besides these, we found numerous bones of animals in both pits, most however in the western, which Dr. Dukes very kindly labelled with their anatomical names. All the above remains are now in the Arnold Library. They were found by W. Ecroyd, G. Jones (M), and myself. The broken condition of the pottery may be ascribed, I think, to the rough usage crockery would meet with from soldiers and travellers in those days.

'Mr. Bromwich, of Wolston, has in his garden two stone mortaria, about a foot in diameter, and the same height, which came from Cave's Inn. Elias Ashmole, writing about 200 years ago to Sir William Dugdale, says that he noticed in a field in front of Cave's Inn, then called New Inn, fragments of Roman brick and pottery dug out from some ditches then made for drainage purposes. The people there have an idea that it is an old place, and that many things have been found there.

'And now a few words on the method of "digging" for pottery, &c. The best weapon is a spiked geological hammer; a cold-chisel is also useful.'

On the '*Visible Proof of the Rotation of the Earth*,' by H. Weisse (A). [The following is the substance of this paper.]

'Imagine a tower 700 feet high: as the earth goes round, carrying the tower with it, the top of the tower being so much higher than the surface of the earth, has a greater velocity: drop a stone from the west side, and before the stone reaches the ground it will have shifted a little further eastward than the ground below it: *i e.* it will strike the ground a little east of the point directly under the top, or a little nearer to the base of the tower. Similarly, drop a stone from the west side, and it will strike the ground a little further from the point directly under the top.

'The measurement of the error thus due to rotation will be easier if the sides of the tower, instead of being vertical, slope a little outwards, so that the stone will strike on the sides.'

The paper shewed how this experiment had been tried in Scotland, a large chimney being used: but Mr. Wilson, while admitting the truth of the principle, proved by calculating the amount of variation due to rotation, that the experiments could hardly be relied upon, the error due to other causes being inevitably so much greater.

On '*Beavers in Bute*,' by anonymous contributor: (see plate 4).

'A drive along the coast, and a few miles inland through fine woods and over a piece of moor, took us to the edge of a wood, where we were met by an oldish man, who is the guardian of the beavers, and of one other animal which I shall presently describe. He led us along a narrow path through grass under fir trees for about five minutes, when we came to a grey wall with an iron gate. This was the entrance to the domain of the beavers. We looked round, and found a little stream descending parallel with the wall we had just passed. We followed a track between the two, and before long saw that the stream on our right was checked and spread out to at least three times its ordinary width. Yes, it really was the first and uppermost beaver's dam. It had been partly spoilt by heavy rain, the man told us, but enough remained to make a strong waterfall about two feet high. Then we looked round at the wood, and on in front. It was a wonderful sight. One's first impulse was to say, "The woodman has been clearing—what a pity!" For all round trees were lying on the banks and some way into the wood on each side, and others still standing were barked all round a little way from the ground. It was amazing to think that all this was the work of a dozen animals about the size of hares! The stumps of the trees are left about half a foot high, finished off to a point. They look like the end of a pencil with no

lead in it, neatly sharpened with a number of short strokes. The prostrate trunks are shaped exactly the same, so that the plan of the beavers is to mark a wide belt round the tree outside, and work inwards from that on all sides to the centre. The man told us they generally managed to make a tree fall in the right direction—that is towards the stream—but sometimes a strong wind put them out. The largest trees they had attacked were about a foot in diameter. They take off the branches and cut them into "junks," the man said, in order to move them, when the trees are not close to the stream.

'Just above their second dam we saw their house, or rather its roof—for all that showed above the water was a rough platform of sticks, slightly raised in the middle, and measuring I should think about a yard across. They have only one at present; but as they have increased from two (or four, I forget which) to twelve in about a year and a half, they will soon want more accommodation.

'They are fed on willow wands, which we saw lying about near their house, neatly peeled. They have burrows on each side of the stream for some distance, where I suppose they live by day. The entrances to these are wattled over with sticks in the most ingenious way. The man pointed out one that had been open a few days before, and said that some one had put a stick down to feel the depth. This was not liked; and when we saw it sticks were fixed firmly across and across, so that you might easily have walked over the hole without noticing it.

'A little further down the stream we came on the most surprising work of all—their third and lowest dam. Its length was about nine feet, I should think. It seemed perfectly firm and water-tight, judging by the height of the water, and the man said it was six feet high as seen from below. (We could not get past to see for ourselves, unluckily). The shape was remarkable: for it was built across the stream in a curve, the bend being greatest towards the strongest part of the current. This dam was built when there were only four beavers, which adds to its wonder. They began, we were told, by laying strong pieces of wood diagonally athwart the stream.

'From this point we had to turn back. It was disappointing not to see the beavers themselves: but this can only be done by peering cautiously over the wall, towards dusk, through the bars of an iron paling. It is no wonder that they have made themselves so thoroughly at home, for we were surprised to hear that a lady who had been to visit them remembered her grandfather saying that he had shot a beaver when he was young on Loch Ascog, a town which lies among the hills not far from their present abode.

'"Get your dinner," said the ox, when the cat asked him what her duty was. (Need I say that I am quoting Froude?) The beaver not only gets his dinner—and peeling willow wands is at least as hard work as munching grass—but builds his house, and lays out his grounds like a gentleman. Engineer, miner, woodcutter, weaver,

landscape gardener, and architect—Mr. Gladstone himself is not more versatile. Admire also his social virtues—the large family in one house, and their co-operation in large works, and quit them as we did with a sense of shame.

'NOTE.—Since writing the above, I have had an opportunity of looking up beavers in Wood's "Natural History," and "Homes without Hands." He says their houses are usually covered with mud, which hardens into a strong defence, and inside each beaver has a separate bed! In the summer these lodges are only inhabited by females with young families: so perhaps next winter our friends in Bute will have to build new houses. Wood says that the burrows in the bark are inhabited by idle beavers who will not work with the others. The hunters call them "Les Paresseux," and capture them with great ease. Wood supposes them to be old bachelors, who retire into solitude in consequence of being defeated in the annual struggle for wives.

'It appears that the beavers store logs in order to peel them for food in winter.

'One characteristic fact remains—beavers are born with their eyes open.'

Some Entomological notes were read, which will be found in the Section Report.

MEETING HELD OCTOBER 27. (present.)

Exhibitions: Sketches in Yorkshire, and blocks of corroded limestone from Ingleborough, by Rev. T. N. Hutchinson. A model screw steam-engine by G. W. Rhodes (A), &c.

Papers: On '*Garianonum*,' an old Roman camp near Yarmouth, by G. Jones. This essay obtained the Society's second prize. Mr. Bloxam kindly offered to give the prize.

Rev. T. N. Hutchinson read the following paper on "*Certain Corroded Limestone Masses in Yorkshire*.' The paper was illustrated by numerous sketches from nature of Yorkshire scenery in the limestone district made during the summer vacation (1877), and also by several blocks of corroded limestone from Ingleborough, presented by Mr. Hutchinson to the Arnold Library Collection.

'Among the various objects of geological interest to be met with in the mountainous district of the West Riding of Yorkshire, the extensive pavement-like masses of limestone that occur in certain localities, with their surfaces fissured, hollowed, and corroded in the

most remarkable way, appear to have attracted less attention than they deserve. Even Phillips, in his elaborate quarto volumes on the Geology of Yorkshire, hardly alludes to them, and ordinary books on Geology, in describing the characteristics of limestone districts, dwell more or less fully on the great caves and pot-holes, but entirely pass over these singular formations.

'Boyd Dawkins, certainly, mentions them in his "Cave hunting," and he points out how completely they exhibit every feature of limestone scenery on a miniature scale.

'Any one who has stayed at Settle, Giggleswick, Clapham, or Ingleton, or indeed almost anywhere in the neighbourhood of Ingleborough, would not be long in noticing the curious and often grotesque pieces of limestone that are frequently to be seen at railway stations, on garden walls, as borders to drives, and on rockeries and ferneries in general. Upon asking where they came from, you would probably be told "From the Fells;" but you might explore many of the Fells without meeting with anything of the kind. Their real home is on the horizontal pavement-like terraces that abound on the north side of Ingleborough, on Moughton Scar, on parts of Whernside, on Giggleswick Scar, and doubtless in many other places. I only mention some of those that I have myself explored.

'Nowhere, however, are they on a more striking scale than on the north side of Ingleborough. Seen from below, on the road between Ingleton and Weathercote, they might pass for mere lines of scars or terraces, such as are common enough in the district; but upon ascending the mountain, their real character is soon observed. They are then seen to be bare level floors or pavements of denuded limestone, often, after rain, shining in the distance like sheets of silver, or, at other times, like snow fields in the Alps. Their smooth pavement-like appearance, however, soon vanishes upon closer inspection; and as you get nearer, they would rather suggest the idea of a glacier converted into stone. They are then seen to be deeply crevassed, fissured, grooved and hollowed out in the wildest way: though, upon careful examination, it becomes evident enough that there are general principles underlying the apparent confusion.

'I have made two sketches of portions of these corroded surfaces—figs. 1, 2, Plate II. The vertical fissures vary in depth from three or four feet to seven or eight, and even more. They are in many cases filled with the most luxuriant fern-growth, the Harts' Tongue (Scolopendrium), sometimes with forked or tasselled fronds, being specially abundant, and the delicate Green Spleenwort (Asplenium viride) frequently making its home in some sheltered nook or crannie.

'A pencil sketch, however, can give only a faint notion of the extreme beauty of these half-hidden natural ferneries as they lie in their little fairy glens.

'The geological structure of Ingleborough is well known. Its

base consists of Silurian slate, greatly disturbed. On the upturned edges of the slate rests the mountain limestone. Next come a series of softer shales and strata, known as the Yoredale series. The summit of the mountain is capped with Millstone grit.

'The Millstone grit and the Yoredale shales have been removed over vast areas, and the denuded surface of the mountain limestone has been left.

'These surfaces are, in many places, almost at a dead level, and, as might be expected, it is on these portions that the corrosive action of rain and weather has been most effective. Other portions, however, are more or less inclined, and the inclination of these slopes has of course determined the drainage system of the entire area.

'Every one knows, or ought to know, that carbonate of lime, of which the so-called "limestone" is chiefly composed, is soluble in water containing free carbonic acid. Rain water contains carbonic acid, partly derived from what it dissolves in its passage through the air, and partly from the decomposing vegetable matter in the surface soil.

'Hence the rain water as it lies on the surface of limestone rocks must gradually corrode them and waste them away. If the surface of the rocks is inclined at an angle, it can only form grooves or furrows down which the water runs; but when the surface is horizontal, it is manifest that the conditions for errosion are specially favourable. In the first place, all limestone is traversed by joints, cracks, and lines of shrinkage. These in ordinary rocks would of course be gradually widened and deepened by the mere mechanical action of running water; but in the case of the limestone surfaces in question, the widening and deepening goes on at a much greater rate, the rock itself being partially dissolved away by the rain water that collects in every joint and crack.

'Hence these give rise to wide chasms and deep fissures, corresponding in fact to the open valleys and gorges of limestone scenery on the larger scale. The lines of joint are more or less at right angles to each other, so that the whole surface is frequently cut up into masses of a rectangular form, in some cases left almost isolated, as huge blocks or vertical columns.

'Here and there softer portions of the limestone in the line of joints have been more deeply corroded, and excavated out into Lilliputian caves, grottoes, and ravines; the miniature representatives of the water-worn caves at Clapham and elsewhere. The vertical walls of the crevasses themselves are also frequently corroded into horizontal grooves and projections, depending upon the relative hardness or softness of the parallel layers.

'Then, again, it is easy to understand how the surface has been pierced in many places with vertical holes of greater or less depth. The rain water rests at first in a slight depression not deeper than a watch glass, and, while doing so, dissolves a portion of the rock and makes the depression deeper. Fragments of sand and rock accumulate in these hollows, and in a storm of rain and wind are

whirled round and round in their beds, still further deepening the shaft. Several such holes will be observed in my drawings (figs. 1, 2, Plate II).

'The various depressions and furrows in the upper portion of the mass give rise to a complete valley system, converging in many cases to one of these holes.

'In this way miniature representations of the "pot holes" at Weathercote, Gaping Gill, and Helln Pot, may be seen in full operation during every storm of rain.

'Another curious result follows from the formation of these circular hollows. Two or three are formed side by side, gradually encroaching upon each other. In the course of time they meet, and so a vertical portion of the rock is isolated. If at the same time an undermining process has been going on by the action of water working its way below, it is completely separated from the adjoining mass, and so is left to itself. Storms dislodge it from its place and bring it lower down the mountain side.

'In fig. 10, Plate III, I have sketched a plan of one of these curiously corroded masses as it lay separated from the adjoining pavement on Ingleborough.

'It is at present far too large and heavy to be easily carried away, its extreme length being twenty-five feet. Before long, however, some of the circular hollows will evidently encroach so much upon their neighbours as to break up the whole into pieces of smaller size.

'There are people at Ingleton and elsewhere, dignified with the name of rockery merchants, who make a regular trade of collecting and selling such dislodged and isolated fragments, and hence their occurrence in so many gardens and rockeries in the towns and villages of the district.

'I have made sketches (Plate III) of a few characteristic pieces, but their shapes and varieties are endless.

'One, fig. 9, is singularly suggestive of the well known Torso; another, fig. 8, might pass muster for an attempt at carving a lamb; while a third, fig. 5, might possibly be mistaken for a gigantic fossil tooth!'

On '*Rooks*,' by H. Weisse (A).

On '*The New Zealand Collection*,' by R. C. Cordiner (M).

'There is no intention in these notes on our New Zealand Collection to produce an exhaustive essay on the flora of the antipodes. This work has already been done well by Sir Joseph Hooker and others. Our intention is, taking the materials which have been sent us, to go through them *seriatim*, pointing out the chief resemblances and contrasts between the orders and genera represented and their relatives at home. Of course no general inferences can be drawn, as the materials at hand form but a very small fraction of the whole New Zealand flora.

'Going through the portfolios in which the plants are now placed, No. 1 contains the Thalamifloral Dicotyledons. Of the orders only three have no British representatives, either wild or commonly in cultivation:

'*Coriariaceae*, an order of one genus only, but spread very widely over the world.

'*Pittosporeae*, an order of shrubby plants of no general interest.

'*Anacardiaceae*, consisting chiefly of trees yielding turpentine.

'The following orders are represented in Britain:

'*Ranunculaceae*, to which perhaps our commonest plants, the buttercups, belong. Of the buttercup genus (Ranunculus) there are five species in the collection, but no representative of the water ranunculus, whose varied forms are so abundant in all stagnant water with us. The genus Clematis, however, which is represented in England by one species only—the Traveller's Joy—has numerous species, many of them of great beauty.

'*Magnoliaceae*. This order, though not native, is well-known to us through our garden Magnolias. There is one New Zealand genus (Drymis) only, of no interest to us.

'*Cruciferae*. This is one of our most interesting orders, containing a large number of wild species, as well as those, like the Cabbage and Turnip, which are amongst the most important of cultivated vegetables. Of this order we have only one New Zealand species, Cardamine hirsuta, certainly one of our commonest weeds, and apparently one of the few plants which, without any alteration in habit, is spread over nearly the whole globe.

'*Caryophyllaceae* has another of these wide-spread plants, Spergularia rubra, confined, however, to the sea-shores of all the continents. There is also a species of Stellaria or Stitchwort, unlike our species of the same genus.

'*Portulaceae*. Montia fontana is the only plant, which is very wide-spread in moist localities.

'*Elatineae* is represented only by an inconspicuous weed, Elatine americana.

'*Linaceae* contains one Linum like our flax.

'*Geraniaceae*. Of the genus Geranium there are three species, including our common G. molle, and one true Pelargonium, to which genus our showy garden geraniums all belong. Also one Oxalis, common in the south-west of England.

'*Malvaceae*. These consist of shrubby plants, with very inconspicuous flowers, whereas our common Mallows are rank weeds, with very large and conspicuous flowers. The peculiar structure, however, of the anthers and pollen, so well known as characteristic of the order, prevails in full force.

'*Tiliaceae*, the order of our Lime Tree, is represented by three species, all tropical, but not specially Australian.

'*Sapindaceae*, known to us by the Horse Chestnut of our woods and gardens, is represented by two species.

'*Rhamnaceae* gives one thorny shrub.

'*Rutaceae* gives one genus of three species, but of no interest.

'The next volume contains the Calycifloral Dicotyledons. Of these two orders are not British, while the remaining ten are native.

'The non-British orders are Myrtaceæ and Ficoideæ, both of which are well known in cultivation. The former contains five species of Myrtle, one Eugenia, which also comprises the Clove plant, and one Leptospermum, a plant sometimes used for tea in its native country. It is to be noticed that no species of Eucalyptus appears, an Australian type of plant, and of special interest as a large and ornamental tree, capable of easy growth wherever the winters are not too severe. It is considered by some authorities as a specific against malarious fever, though this point is not universally admitted.

'The order Ficoideæ furnishes the Mesembryanthemums of our greenhouses, natives only of Africa and Australia.

'The following orders are British:

'*Leguminosae*, remarkable for an entire absence of Trefoils and Vetches, the order being represented by one plant unknown to us.

'*Rosaceae*, represented by two species of Rubi, neither of which look promising for blackberry gatherers.

'*Onagraceae* comprises one Fuchsia and five Epilobiums, all similar to our species, but none of them identical.

'*Haloragaceae* contains two plants, also British.

'*Droseraceae*, a family now historical, owing to Mr. Darwin's researches on their insectivorous habits, contains two species of the typical genus Drosera.

'*Crassulaceae*. One plant only, the Tillœa muscosa, which is also British. The typical genera Sedum and Crassula seem to be absent.

'*Saxifragaceae* is represented by two shrubby plants, which would at first sight pass for anything rather than Saxifrages. The absence of this cosmopolitan genus is remarkable, if it be more than accidental in this collection.

'*Umbelliferae* includes, with others, two British genera, Hydroctyle and Apium.

'*Araliaceae*, the Ivy family, is represented by species of Ponax, an East Indian and Australian genus.

'*Corneae* contains two plants almost confined to New Zealand.

'Of the Gamopetalous orders, two, Myrsineae and Loganiaceae, are altogether Australian, and thirteen have British representatives.

'*Loranthaceae*. One plant only of the genus Viscum, to which Miselto belongs.

'*Rubiaceae* contains two Galiums, of smaller foliage than most of our species.

'*Compositae*, the most wide-spread family in the world, numbering over ten thousand species, is well represented in New Zealand by peculiar forms of no general interest. Almost the only genus known to us is Senecio, of which there are several species similar to our large groundsels. There also are two Gnaphaliums.

'*Campanulaceae* produces no Bluebells, and of British genera only a Lobelia. There is also a Wahlenbergia, which is sometimes cultivated in our gardens.

'*Ericaceae* contains a number of plants quite different in character to ours, a type which is approached somewhat in the Gaulthereas.

'*Jasminaceae* is represented by an Olive.

'*Apocynaceae*, by two Parsimonias, unlike any plant known to us.

'*Convolvulaceae* contains the small seaside C. Soldanella, which is common on our shores.

'*Boraginaceae* yields a Myosotis similar to, but not identical with, our Forget-me-nots.

'*Solanaceae* contains a Solanum similar to ours, and two apparently shrubby species bearing a large fruit, to which the native (?) name, Poroporo, is attached.

'*Scrophulariaceae* contains one Veronica, apparently a beautiful plant, but not identical with any of our Speedwells.

'*Primulaceae* gives no true Primrose, but a species of the very anomalous genus Samolus, with which we are familiar.

'*Plantaginaceae* contains one Plantain.

'Among the Monochlamydeous orders there are a few purely Australian, among which the Proteaceæ stand foremost. The following are of interest to us, as allied to plants in our flora:

'*Chenopodiaceae* contains the characteristic genera Chenopodium and Atriplex, with one Salicornia.

'*Polygonaceae* contains one true Dock.

'*Thymelaceae*, the Daphne family, contains the genus Pimelia, often cultivated with us as pretty greenhouse shrubs.

'*Euphorbiaceae* yields one true Spurge.

'*Urticaceae* contains two Stinging Nettles, and a plant very near to the Wall Pelitory.

'*Coniferae* yields a number of plants apparently similar to our Juniper.

'The Monocotyledonous orders are nearly all known to us, though very few of the species are identical.

'*Orchidaceae* seem very numerous, most of the species being epiphytal. The terrestrial ones are none of them members of British genera.

'*Iridaceae*, one species only, not allied to British forms.

'*Liliaceae* are numerous, but our typical plants, such as Hyacinths, Lilies, and Garlic, seem absent. The plant of most interest is the New Zealand Hemp (Phormium tenax), from whose fibres very strong cordage is manufactured.

'*Juncaceae* consists of plants of the same rush-like type as ours, one or two species being identical. Of true Junci there are two, but not British species.

'*Palmae* contains a single leaf of the Betel-nut.

'*Restiaceae*, which gives us a single plant, probably a wanderer from America, confined to the Isle of Skye and the West of Ireland, has two New Zealand representatives.

'*Naidaceae* is represented by Lemnas and other British genera, containing species of the same type as our own.

'*Cyperaceae* and *Gramineae* contain Sedges and Grasses very similar to ours, many of the genera and a few species (*e.g.* Scirpus maritimus) being identical.

'The last portfolio (No. VI.) contains Ferns and Naturalized Plants.

'The Ferns are very numerous, and remarkable alike for beauty and size, many of them being tree ferns, for which New Zealand is one of the most remarkable countries in the world. Three species only are British—Pteris aquilina, the common Bracken, which, however, differs from our plant in having the terminal half of the pinnæ simple instead of being divided into secondary pinnæ; [see a careful drawing of this by H. F. Wilson, on plate 8:] the Ophioglossum vulgatum, which, judging from the sample before us, must be a veritable pigmy. The last is the Hymenophyllum Tunbridgiense, or Tunbridge Filmy Fern.

'Of Naturalized Plants, as might be expected, the larger portion are British, many of them being our commonest weeds—Glaucium Luteum, Fumaria muralis, Erysimum officinale, Sagina procumbens and apetala, Stellaria media, Polycarpus tetraphyllum, Vicia sepium, Trifolium pratense and procumbens, Hypochœris glabra, Verbascum Thapsus, Plantago coronopus, Cynosurus cristatus, Poa pratensis, Bromus sterilis, Hordeum murinum, Glyceria fluitans.

'It is dangerous to generalise in so small a collection as that before us; but we may be permitted to point out, in conclusion, that while of the Dicotyledons a large proportion even of the orders are peculiar to Australia, none of the Monocotyledonous orders are peculiar. On the other hand, the genera and species of the Dicotyledonous orders which we have in common with New Zealand are frequently identical, but among Monocotyledons next to never. This comparison, if worth anything, points to a higher antiquity of the Monocotyledonous as compared with the Dicotyledonous type, the former having spread over the world, and established its most striking ordinal forms, before the latter had come into existence. More lately, however, the Monocotyledons have developed no new forms, whilst the Dicotyledons have overspread the world with their varied forms.'

Mr. Bloxam gave a very interesting account of '*Archæological Rambles.*'

MEETING HELD NOV. 17. (100 present.)

The President announced the proposed publication of the '*Midland Naturalist,*' the journal of the new union of societies.

Exhibitions: A perfect diamond crystal, by L. Leverson (O.R.): Yorkshire stalactites, by Mr. Hutchinson; &c.

Mr. Hutchinson then exhibited a new electric gaslighter and jet combined. It consists essentially of a small electrophorus, the ebonite plate of which is rubbed by a disc of leather attached to a brass plate. The brass plate being charged is lifted, and a spark, passing between two wires above the jet, ignites the gas.

Papers: On '*Autumn Moths*,' by J. Lea (A).

'Though with the end of summer a large proportion of moths, and nearly all butterflies, disappear, yet there is no reason why the entomologist should be idle during the autumn and subsequent months, as there are several ways by which good additions may be made to a collection then. To begin with, though not necessarily first in point of time, there is the ivy, which happens to have been very late in flowering this year, generally flowering towards the beginning of October: to this come most moths that are out in October, principally Noctuas, though a few geometers, some of course being very common, and some very good ones.

'The largest class of moths that come to ivy-bloom are the chestnut Noctuae, that is to say, the genera Orthosia and Anthocelis; these have all a general type in colour and marking, being of a red brick colour, and having two conspicuous spots on their upper wings. The next class may be called -agos, that is, those moths whose names end thus; for example, Aurago, Silago, &c.: these are a bright orange or yellow for the most part, with some red in them. Then there are some casual ones: for instance, Aprilina, a fairly large mottled green moth, Oxyacanthae (the green brindled crescent), and Meticulosa, a large brown moth with very striking markings, all coming near each other in order. Hence it will be seen that the moths that frequent the ivy are of a peculiarly bright colour, mostly red and yellow, possibly to look like dead leaves, and that they must make a considerable show in a collection, besides there being, as I said, several rarities among them. I might add that the Society's collection is somewhat deficient, even in the commonest.

'But how, and where, and when are they to be taken? Though they may of course be taken by an ordinary net, yet I think the following ways are more suitable. 1st, You can take them straight off the flower, putting them into a chip box or killing bottle, if within reach; 2nd, you can beat them down into a sheet spread below, or into an inverted umbrella, which I think we should find most convenient; lastly, this may be used, combining a net and lantern, which latter will be required in all cases. The best place I know in Rugby would be the ivy on the Doctor's wall between the White Gate and the Hillmorton Road, though the lamp in the middle might rather scare the moths from coming to its immediate

proximity. The best time is just after dark, when they are all there, and have not begun to crawl away, having dropped off the flower in a state of intoxication. But here there is a difficulty: locking-up comes just at the right, or I ought to say just at the wrong time on half-holidays, and so we are cut down to a passing glance on the way up from fifth lesson, when our time is decidedly limited.

'The next way I shall speak of for taking moths in autumn is somewhat curious, and very unnatural. About this time a certain set of moths are to be found on ponds—certainly a very unnatural place for them, and I see no reason unless it is that they have fallen off the bushes above them. The moths to be found here are the hibernidae or winter moths, and there are some seven or eight species of them. They are not often to be found as particularly good specimens, though fit for a collection as a new sort. The ponds, however, must be of a certain nature; they must be stagnant, well overgrown by bushes, and so rendered dark; and they must be free from weeds. Perhaps even better than ponds are ditches, where the water is stagnant and well overgrown by the hedge. I have not as yet thus discovered any moths in the neighbourhood of Rugby, though I have searched all the likely ponds.

'But by mentioning these unusual methods of taking moths, I do not mean to imply that in these ways alone it is possible to procure them; for such accidents as a year when moths, like all other things, are behind their time, or a warm autumn, (both of which are applicable to this year,) may cause several moths to be found in autumn. Then the second broods of a few moths come out in October: for example, the vapourer. On the 14th of October I saw three male specimens of this moth, and caught one; and some ten days afterwards I found a female of the same moth, just emerged from its chrysalis—this I had intended to exhibit, as one of those curious moths that are absolutely wingless, and whose bodies are shaped differently from ordinary ones, resembling a large spider more than any insect I know. Unfortunately, however, I had put it away in a box without a lid, and a mouse thought fit to eat it one night, together with the body of the male, leaving me the wings.

'Besides these, I have seen several geometers this term that have come into light; the last one of which I observed on November 13th, which was the winter moth (Brumata), one of those that I have before mentioned as being found on ponds. Then, too, during this term is the time for taking moths in the chrysalis state; but as I have already encroached too far on the Society's time, I will defer my remarks on this way of enriching a collection to another evening.'

On the '*Temple Observatory*,' by W. E. Home.

On '*Plants in the Dark*,' by M. M. Adam.

On '*Cleopatra's Needle*,' by H. F. Wilson.

Mr. Bloxam related the history of the Winter Horse Fair at Rugby, stating that it was over 600 years old. He then made some interesting remarks on Archæology.

MEETING HELD DEC. 8. (97 present.)

Exhibitions: Persian sword in repoussé work, by L. A. Adamson: Rugby Botanical Collection, to be sent to New Zealand, by H. F. Johnson: &c.

Mr. Hutchinson shewed a Wheatstone machine for exhibiting wave-motion.

Papers: On '*White Lias Formations near Rugby*,' by T. B. Oldham. The bulk of this paper has been embodied in the Geological Report for the year.

On '*Hydrophobia*,' by W. E. Home.

On '*Oceanic Circulation*,' a very interesting paper, by H. N. Hutchinson (c), explaining the rival theories of these currents, which ascribe them respectively to gravitation and wind.

REPORTS OF SECTIONS FOR 1877.

Meteorological Section.

THERE is nothing calling for any very special remark on the general work of this Section. A chart shewing the readings for the year has again been prepared. The drawing was made on transfer paper, with some care, but the lithographic printer has not been successful in the printing process, the lines having become rather blurred and irregular in many places. I shall hope to secure a better result another year.

The lowest barometer reading was recorded on November 11th. At 8.15 a.m. on that day the mercury stood at 28.848 inches: by 9.30 p.m. it had fallen to 28.270. This corrected for temperature and sea level gives 28.641 inches. After 9.30 p.m. the mercury began to rise.

The rainfall for the year was 28.71 inches, less than that of 1876 by 1.93 inches, but still more than five inches above the Rugby average. The actual number of days on which .01 inches, or more, of rain fell, was 195, while the corresponding number in the previous year was 182.

The two wettest days were January 3rd, when 1.01 inches were recorded, and August 27th, when the fall was 1.05 inches.

On July 14th and 16th, heavy rain fell over the Midland Counties, but the fall was less at Rugby than in many other localities: .71 inches was the amount recorded on the former, and .80 inches on the latter day.

I wish again to call attention to the extreme importance of accuracy and regularity in taking the observations with all the instruments. The weak point during the past year has been the readings of the wet and dry bulb thermometers at 8.15 a.m.

One or two observers have, upon some occasions, forgotten or neglected to take the readings till after *second* lesson, when the thermometers would often have altered considerably.

Fortunately, by comparison with my own observations, I have in all cases detected the error, but I should like to feel that the figures entered at the time were really to be depended upon, without being necessarily checked by myself.

The following have assisted in the work during the past year:

Mr. Percy Smith. Mr. Kirk (during vacations).
H. St. J. Bashall. W. E. Home. F. Rothera.
H. E. Bristow. F. Martin. W. C. Sellar.
R. E. Cordiner. G. W. Rhodes. R. E. Tanner.
W. Ecroyd.

The list of observers is smaller than in other years: partly accounted for by the fact that one or two have, at their own wish, continued taking the readings for more than the usual month.

H. St. J. Bashall has recorded the readings of the barometer for more than six out of the twelve months with unfailing accuracy and regularity.

T. N. Hutchinson.

Meteorological Observations, 1877.

January.

Date	Barom. Re-duced.	Temperature Dry Bulb.	Wet Bulb.	Max.	Min.	Rain — inches	Date	Barom. Re-duced.	Temperature Dry Bulb.	Wet Bulb.	Max.	Min.	Rain — inches
1	28,720	48,2	47	49,6	38,4	,10	18	29,778	41,6	40,6	53,8	36	,07
2	29,679	38,8	32,2	38,2	33	,03	19	29,661	54	52	55,2	40	,01
3	29,566	37,6	37	38,4	33	1,01	20	30,303	37,4	37	51,6	34	trace
4	29,155	48,2	43,2	52,4	41	,01	21	30,604	39	37,4	46,6	34	trace
5	29,169	42,4	41	48	41	,07	22	30,588	36,2	34,8	45,2	34,2	trace
6	29,283	40	38	49,2	38	,20	23	30,387	37,4	34,8	45,4	30	,09
7	29,065	44,6	43	49	39,4	trace	24	30,067	40,4	38,8	46	34,4	,05
8	29,465	48	46,8	49	43,6	trace	25	29,685	43,8	43,6	48,4	34,2	,11
9	29,685	44,2	44	48,6	43	,15	26	30,008	35	33,2	43,4	38,8	,08
10	30,067	36	36	43	35	,05	27	30,112	37	36,4	45,8	30	,05
11	29,804	37	35,2	38,4	35,2		28	29,896	45,4	43,8	53	35	,08
12	29,827	28,6	28,2	37,2	27	,03	29	30,087	34,6	32,2	47,2	32,2	,40
13	30,047	34	33	44	33	,13	30	29,238	45,2	44,8	45,6	37	
14	29,777	43,3	43,2	48	37	,03	31	30,062	35,4	33,6	46,4	33	,20
15	29,988	33	32	42,2	32,4	,04							
16	30,034	43,8	43	50	37	,03	Average	29,799					Total
17	29,775	49	48	49,4	40	,08							3,10

February.

Date	Barom. Re-duced.	Temperature Dry Bulb.	Wet Bulb.	Max.	Min.	Rain — inches	Date	Barom. Re-duced.	Temperature Dry Bulb.	Wet Bulb.	Max.	Min.	Rain — inches
1	29,962	46,4	45,6	49	35	trace	17	29,947	41,2	39,2	49	38	,01
2	30,028	48,6	48	52,2	43,6	trace	18	30,066	47,8	46,7	50,2	41,2	,13
3	30,166	37	35,4	47,6	34	,02	19	29,910	36,1	35,7	48,6	36	,47
4	30,085	41,5	38,2	48,2	35	trace	20	29,268	36	35,5	44	34	,01
5	30,290	39,2	38	47	32	,01	21	29,840	36	33	40,4	33,8	trace
6	30,269	46,5	46	51	46	trace	22	30,100	30,6	29,8	39,4	29,2	,13
7	30,073	52,5	50,6	53	45	,20	23	29,960	36,1	35,5	43	36	,02
8	30,206	39,2	39	50,2	37,2	trace	24	29,680	44,1	43	48	36	,02
9	30,097	40,8	39,4	50	36	trace	25	29,373	46,5	44	49,8	43	,26
10	29,865	49,2	47,7	53,6	45,8	,06	26	29,204	32,2	32,1	39,6	32	,20
11	29,756	49,5	45,2	55	45	,18	27	29,902	31,8	31,2	39,4	27	trace
12	29,742	44,9	44	51	43,2	,01	28	30,202	26,6	froz'n	36,8	23	
13	29,720	45,5	44,2	48	42	,27							
14	29,952	48,9	47,6	54,6	41	trace							Total
15	29,895	47,8	46	52,4	44	,15	Average	29,904					2,15
16	29,779	36	35	52,8	34	trace							

March.

Date	Barom. Reduced.	Temperature Dry Bulb.	Wet [illegible]	Max.	Min.	Rain — inches	Date	Barom. Reduced.	Temperature Dry Bulb.	Wet Bulb.	Max.	Min.	Rain — inches
1	30,405	26,8	23,8	44,8	20,4	,04	18	29,654	48,2	46,1	52,2	32	,01
2	30,205	43,2	43,1	53,6	35,4	,10	19	29,660	32	31,5	47,8	[illegible]	trace
3	30,118	46,2	46	50,2	45	,20	20	29,460	31,5	27,2	41	27,2	
4	29,865	44,7	44,3	48,6	38	,29	21	29,396	33,7	31,5	44	30	
5	29,942	36,5	35,7	46,4	32	,10	22	29,705	31,7	25	51,8	25,4	,01
6	29,950	34,2	32,8	43,6	30	,11	23	29,772	35,2	31,7	47,2	26,4	,18
7	29,404	33,2	31,9	41	31	,19	24	29,267	37,6	36,2	50,6	32,8	,19
8	29,979	31,2	frozen	39,6	·29	trace	25	28,951	44,2	42,7	54	41	,03
9	30,141	32,1	28,8	40	28	,03	26	29,230	40,3	40	[illegible]	39	,03
10	30,102	31,7	29,2	41,6	31,6	,03	27	29,278	42,2	40,5	53,2	38,4	,13
11	30,229	32,1	29	44,8	26,6	trace	28	29,677	45,5	42,5	56,4	37	,02
12	29,880	46,1	44,5	48,6	36	,01	29	29,870	42,2	42,1	53,2	37	,02
13	29,769	44,1	40,2	47	40,6	,03	30	29,997	44,2	43,2	57,2	40	
14	29,860	49	45,2	53,4	43,8	trace	31	30,124	44,9	42,2	49	39	,01
15	29,938	42,2	40	49,2	38	,05	Average						
16	29,531	38,4	35,2	49	34	trace		29,771					Total
17	29,555	35,2	32	46	30,2	trace							1,81

April.

Date	Barom. Reduced.	Dry Bulb.	Wet Bulb.	Max.	Min.	Rain inches	Date	Barom. Reduced.	Dry Bulb.	Wet Bulb.	Max.	Min.	Rain inches
1	30,048	45	[illegible]	53,4	43,6	,04	18	2	39,2	37	42,2	35	,01
2	29,993	45	42	56,4	39		19	2	40	37,4	48	37,2	
3	29,488	49,2	47	53,4	46	,26	20	3	43,8	40	55,6	31	,21
4	29,167	49,8	47	56,2	45	,22	21	2	41,8	41	[illegible]	40	,08
5	29,259	46,6	44	50,2	37,2	,16	22	2	52,6	50	63	44	,13
6	29,449	43,8	42	52,2	37	,12	23	2	46	42,4	52,4	36	,02
7	29,636	43	41,2	53,5	36,5	,28	24	2	44,8	42,2	55,2	35	
8	29,676	47	46	54	40	,12	25	2	44,8	41	54,4	34	
9	29,537	[illegible]	45	50,5	44	,67	26	3	42,8	39,4	50,2	30,6	
10	29,532	45,6	44	57	43	trace	27	2	43	40	48,4	35	
11	29,676	41,4	40,2	56,4	40		28	2	41,8	39,8	45	37	
12	30,064	42	39,2	48,2	34	,03	29	2	41	39,6	47,6	37	trace
13	29,994	43	41,2	52	36	,04	30	3	40,6	38	51,2	36,6	
14	30,116	43	41,8	52,6	40		Average						
15	30,082	44	40	50,2	40,4								Total
16	29,748	43,4	37,6	47	38			2					2,40
17	[illegible]	42,2	38,2	46,6	34	,01							

May.

Date	Barom. Reduced.	Dry Bulb.	Wet Bulb.	Max.	Min.	Rain inches	Date	Barom. Reduced.	Dry Bulb.	Wet Bulb.	Max.	Min.	Rain inches
1	30,410	40	36	46,2	31		18	29,941	54,5	49	59,2	40	,24
2	30,336	43	37	52,8	33,2		19	29,827	45,5	44,8	52,6	40	,13
3	30,181	40,7	38,5	45	31,6		20	30,158	44,8	43,2	49,8	44	,06
4	30,145	38	35	49,8	26		21	30,253	48,4	45,8	57	42	trace
5	29,924	40,2	36	50,6	26,2		22	30,307	43,8	41,4	46,2	42	
6	29,891	43	[illegible]	55,6	28,6		23	30,301	48	45,2	51,2	38,4	
7	29,849	45,7	42,5	61,2	30,6		24	30,267	47,5	43,5	54,6	40	
8	29,794	52,5	44,5	64	[illegible]	,06	25	30,255	45,8	44	62,4	37,8	
9	29,557	46	45	63	40,6	,04	26	30,194	53,4	[illegible]	61,6	42	
10	29,582	49,6	46,6	62,2	46,2	,15	27	29,823	51,8	47,2	62,2	42,6	,17
11	29,565	47,2	[illegible]	58	44	,05	28	29,183	53,6	48,5	59,8	49,6	,09
12	29,607	48,2	47	58,2	44	,05	29	29,530	51,2	45,8	61	42,2	trace
13	29,712	46,5	[illegible]	55	45,6		30	29,596	53	47,2	62	41	trace
14	29,675	53,4	52	55,6	43,6		31	29,596	55,2	50,4	64	42	,26
15	29,808	48,6	48,2	62,2	46	,02	Average						
16	30,073	53	50	61	40	,33		29,767					Total
17	29,853	50,2	49,2	54	50	,15							1,80

June.

Date	Barom. Re-duced.	Temperature Dry Bulb.	Wet Bulb.	Max.	Min.	Rain — inches	Date	Barom. Re-duced.	Temperature Dry Bulb.	Wet Bulb.	Max.	Min.	Rain — inches
1	29,329	53	51	60,2	50	,73	18	30,105	63,5	59	82,2	50,2	
2	29,751	53	51,5	57,2	49,4	,03	[illegible]	30,147	66	60	78,6	52,2	
3	29,792	61	57	75,4	47		20	30,103	63,5	54	78,2	48,4	
4	29,764	62	58	75	[illegible]	,01	21	29,971	61	52	75	49	,20
5	29,830	56	51,2	69	51		22	29,629	59	56	69	53,6	,05
[illegible]	29,987	54	51,5	62,2	44	,12	23	29,793	54	50	60,2	50	
7	30,119	54	49	64	44		24	30,118	54	50,5	67,2	38	
8	30,152	55	49,7	70	43,4	trace	25	30,180	57	52	64,6	39	trace
9	30,078	[illegible]	55	68	50,4		26	30,068	60	56	63	52	trace
10	30,112	58	52	71	51		27	30,154	57	51	66,8	53	trace
11	30,117	61,5	58	73,8	51,8		28	30,371	[illegible]	[illegible]	77,2	46	
12	29,919	62,5	60	63,6	54	,04	29	30,219	64	56	[illegible]	55	
13	30,050	56	54	60,2	51		30	30,227	59,5	57	74,8	55,2	
14	30,169	55,5	51	70,2	46								
15	30,222	58	54	73,2	46,2								
16	30,214	59,5	55	76,2	45		Average	30,035					
17	30,169	53,5	51,5	78,6	47								Total 1,18

July.

Date	Barom. Re-duced.	Dry Bulb.	Wet Bulb.	Max.	Min.	Rain inches	Date	Barom. Re-duced.	Dry Bulb.	Wet Bulb.	Max.	Min.	Rain inches
1	30,054	58,2	52,5	65,6	55	,03	18	29,919	56,5	52,7	66,2	52	trace
2	30,001	59,7	54	70	[illegible]	trace	19	29,859	59,5	57	66,2	53	,07
3	29,998	59,2	52,2	69,6	47,8	,10	20	29,726	54,5	49,5	66,6	46	
4	29,998	57,5	52	69,2	47,8	,01	21	29,990	57,7	53,7	66	46,2	
5	29,950	56,2	51,2	68,2	42	,05	22	29,788	58,2	55,2	66,2	52,4	
6	29,879	53	50,5	63,2	[illegible]	,11	23	29,609	61,5	59	[illegible]	59	,54
7	30,128	52	48,5	65,2	42,2		24	29,553	58,2	54,2	68	50	trace
8	30,244	[illegible]	50	60,4	39,4	,04	25	29,876	61	55	68,2	51	,45
9	30,293	55,7	52,7	65,8	47	,01	26	29,813	56,4	56	72,8	53,4	
10	30,199	63,5	58,5	76,2	56	trace	27	30,131	60,4	57,6	70	52	,01
11	30,081	59,5	56,7	71,4	55		28	30,159	57	55,4	64,4	[illegible]	
12	30,042	59,7	53,7	69,6	50		29	30,226	67,4	64,2	80,6	56,6	
13	29,800	60	[illegible]	70,2	47	,06	30	30,279	62,6	60,4	77,2	56,4	
14	29,559	62	60	67	56	,71	31	30,061	59,8	58,6	75,6	56	trace
15	29,144	56	55	62,4	55	,27							
16	29,294	55,7	53,7	61	52,6	,80	Average	29,906					Total
17	29,438	55	54,5	63,2	54	,45							3,71

August.

Date	Barom. Re-duced.	Dry Bulb.	Wet Bulb.	Max.	Min.	Rain inches	Date	Barom. Re-duced.	Dry Bulb.	Wet Bulb.	Max.	Min.	Rain inches
1		58	51,6	66,6	51,6		1		62	59	70,8	52,2	,61
2		56,4	52	65,6	45,6		1		60,4	60,4	66	57,2	,23
3		57	52	66,2	48,2	,12	2		64	63	77,6	58	trace
4		55,2	51,4	66	48,6		2		65	60,6	71	58,4	,05
5		64	59	73,8	51	[illegible]	2		63	59	66,2	55	
6		63,4	57,8	74	54	,01	2		55	50	66	55	
7		66,2	60,6	67	57	,25	2		56	51	65	50	
8		60,4	57,8	68	52	,19	2		57	54	62	50	,32
9		61,6	57	67	56,4	,06	2		58	58	63	58	,47
10		59	53	69	52,4		2		60	60	63	57	1,65
11		54,2	53	66,6	49		2		58	56	68	58	trace
12		58	55	67,2	44		2		[illegible]	55	68,8	48	
13		63	59	74,2	55,2	,08	3		59,6	54	67	44	,05
14		61,2	60	73,6	57,6	,13	3		58	[illegible]	68	[illegible]	
15		60	59,8	71	58	,02							
16		62	60	70,6	56	,25							Total
17		62,4	57,8	67,4	[illegible]	trace							3,89

September.

Date	Barom. Reduced.	Temperature Dry Bulb.	Wet Bulb.	Max.	Min.	Rain — inches	Date	Barom. Reduced.	Temperature Dry Bulb.	Wet Bulb.	Max.	Min.	Rain — inches
1	30,102	53,4	49	64,8	42,2		18	30,384	48,4	47	61	46,2	
2	29,968	56	41	61,2	43	,43	19	30,090	54	52,2	56,4	48	,11
3	29,769	49	49	49,8	44	,66	20	29,863	48,4	48,2	55	45	,01
4	30,285	50,2	47,4	62,6	41	trace	21	29,829	45	42,2	56	36	trace
5	30,323	50,4	47,4	64,6	36,6		22	29,977	44,6	41	56,6	35,8	,07
6	30,019	52,8	49	63	42,4		23	29,923	51	50	60,2	42,6	trace
7	29,889	52,4	50,2	58	49		24	30,069	49	46	56,4	41,4	
8	30,023	53,6	50	63,8	39,6		25	30,238	42,4	41,4	50	34,4	
9	30,048	56	53	64	47,6	trace	26	30,286	48,2	47,2	64	39,8	
10	30,037	54,2	52,6	60,4	44		27	30,311	43,4	43	60	41	
11	29,798	60	57,8	62,2	53	,33	28	30,358	49,2	47,2	65,6	38,2	
12	29,778	57,8	55	65,2	51	,03	29	30,283	45	44,4	64,8	37,6	trace
13	29,952	56,2	54,4	60,2	49	,03	30	30,227	54	52	65	44	trace
14	29,872	59	54,2	66	56	,18							
15	29,753	56,4	53,2	62	57								
16	30,388	53	51	66	46	trace	Average	30,072					Total
17	30,343	50,8	48,2	58	42,6	,01							1,86

October.

Date	Barom. Reduced.	Dry Bulb.	Wet Bulb.	Max.	Min.	Rain inches	Date	Barom. Reduced.	Dry Bulb.	Wet Bulb.	Max.	Min.	Rain inches
1	30,235	46,4	46	61,8	39		18	30,378	34,5	33,5	50,2	31	trace
2	30,097	41,6	40,8	64,6	33		19	30,249	41,4	38,2	56,6	34	,08
3	30,015	44,6	43,8	63,6	35,2		20	30,122	47	45	58	32	trace
4	30,177	44,8	44	63,2	35		21	29,873	50	46	54,8	45	,13
5	30,355	46,2	44,6	64	36,8		22	29,769	53	51	57,8	48	,18
6	30,690	46,4	44,8	61	36,8	trace	23	29,417	45	44	51,6	39,4	,09
7	30,572	41,4	40,2	55	33,6	,02	24	29,515	40	38	55,8	37	,16
8	30,230	50,8	46,6	54,6	44		25	29,309	48,5	48	54,4	40	,02
9	30,359	44,8	42,4	48,4	37,4		26	29,766	47	46	55,4	43	trace
10	30,027	43,6	42,2	52,8	40	,09	27	29,821	49,6	48,2	54	43	,14
11	29,912	45,8	45,2	56,2	40	,01	28	30,055	46,2	45,4	61	44,2	,21
12	29,910	47,8	45	55,6	42	,11	29	29,773	51,8	48,8	57	42,6	,53
13	29,752	55	54	59,6	43	trace	30	29,805	46,5	45,5	59	44,4	,03
14	29,737	55,5	53	68	43	,03	31	30,083	47	43,5	58,2	45	
15	29,621	49	45	56	42	,08							
16	30,070	42,5	42	44,2	35,4	,01	Average	30,000					Total
17	30,337	39,5	36,5	46	31,6	,06							1,98

November.

Date	Barom. Reduced.	Dry Bulb.	Wet Bulb.	Max.	Min.	Rain inches	Date	Barom. Reduced.	Dry Bulb.	Wet Bulb.	Max.	Min.	Rain inches
1	30,380	46,8	44,2	57,4	43		18	30,097	37,6	36,4	51,6	36,6	,03
2	30,225	44,6	43,2	50,4	40	,10	19	29,922	37,2	36	46,2	32	,11
3	30,039	42	40,8	52,8	37		20	29,532	37,6	35,8	45,2	34,6	,01
4	29,920	47,8	46,6	54	36		21	29,780	36,4	34,2	53	33	,21
5	29,766	49,6	47,2	58,4	45	,19	22	29,168	45,8	43,2	50,4	43,2	,19
6	29,638	55,2	54,6	57,4	47,2	,24	23	29,503	42,4	38,8	50	36	
7	29,636	50,2	49,8	55	46		24	29,602	36,1	34,2	39,8	31,6	
8	29,817	44,8	43,2	56	40,6	,14	25	29,783	35,2	32,2	46,4	31,4	,03
9	29,572	51,6	50,2	56,4	46,2	,39	26	29,948	37,6	35,2	47,2	30	,39
10	29,314	47,4	44,2	53,4	45	,11	27	29,303	45,6	43,8	46	40,4	,02
11	29,219	48,2	45,4	50,8	43	,51	28	29,230	35,8	34,2	46,2	34	,05
12	28,887	41,2	37,8	47,6	41		29	28,791	44,8	42,2	45,6	36,8	,04
13	29,328	38,2	37,4	51,4	35		30	29,044	38,8	37,2	45,2	35	,02
14	30,053	38,4	37,6	51,8	33,6	,03							
15	30,242	53,8	51,2	56	39								
16	30,252	52	49,6	53,2	37,2		Average	29,680					Total
17	30,435	38,8	36,2	52,4	37								2,81

December.

Date.	Barom. Reduced.	Temperature. Dry Bulb.	Wet Bulb.	Max.	Min.	Rain — inches	Date.	Barom Re-duced.	Temperature. Dry Bulb.	Wet Bulb.	Max.	Min.	Rain — inches
1	29,242	36,2	34,8	45	33,6	,01	18	30,548	35,8	35,8	45,6	33	trace
2	30,018	40,2	38,8	47,4	33	,05	19	30,603	32,4	31,8	46	28,6	,03
3	30,263	43,6	42,2	44,4	38	,04	20	30,672	39	39	41,4	38,6	,04
4	30,078	42,2	41,8	44,2	40,2	,03	21	30,498	41,4	40	45,4	38	trace
5	30,037	38,2	37,8	41,6	37	,32	22	30,283	44,2	44	49	41	,06
6	29,465	44,6	43,2	51,6	39		23	30,089	38	37	44,4	36,4	
7	29,875	38,8	37,2	43,2	37	,01	24	29,747	42	39,2	42,6	34	,09
8	30,132	31,4	31	47,8	31		25	29,779	31,6	31	41,2	29,8	,10
9	30,187	41,2	38,8	46,8	35,2		26	29,323	30,6	30,4	39	26,8	trace
10	29,984	36,4	35	40,4	34,8		27	29,585	29,4	28,2	38,8	26	trace
11	30,082	36	35	49,6	29,6	,10	28	30,021	31	30	40	27	,65
12	29,659	46,6	43	49,4	37		29	29,575	47	46	53,4	32,6	,01
13	29,885	35	33,8	42,4	33		30	29,716	45,4	45	49,6	41,2	,41
14	30,195	34	33	46,2	32,6	trace	31	30,031	37,6	36	45	35	
15	30,491	32,8	32	43,2	30,4	,07							
16	30,327	43,4	42	47,4	38,6	trace	Average	30,255					Total
17	30,401	40,6	39,8	46	39,6								2,02

NOTE.—The fall on Dec. 25, 26, 27, was snow: and on Dec. 28 mingled snow and rain.

Archæological Report.

This Section was instituted at a meeting of the members of the Society after the last meeting of the Summer Term. A note-book was also started at the same time for the papers read on Archæological subjects, notes of meetings, Archæological specimens, &c.

An Archæological Museum has been attempted, which as yet is not large enough to have its catalogue printed. It contains specimens of Roman Pottery from the Roman '*mansio*' of Tripontium, on the Watling Street, from Long Lawford, and from the supposed '*mansio*' at Princethorpe. There are also some bits of Roman brick from the Roman camp of Garianonum (now Burgh Castle), near Yarmouth. There are also a few other miscellaneous objects of antiquity. There is also a collection of foreign curiosities found scattered about in the Arnold Library, and a Chinese Collection has been presented by W. E. Home (M).

Four Archæological Papers have been read: 1. by H. Bashall (M), on Princethorpe; 2. by H. Bashall (M) and G. Jones (M), on Tripontium (now Caves Inn); 3. on Garianonum, by G. Jones; 4. on Archæological Rambles in the Summer Holidays, by M. H. Bloxam, Esq., F.S.A. (H).

Not much has yet been done in the way of Archæological work. Tripontium has been carefully examined, but not sufficiently for any report to be made of it. The Roman ground at Princethorpe and Long Lawford has also been examined. From all these pottery has been collected, which has been arranged in the Arnold Library. The churches of the neighbourhood are also being explored.

It is hoped that Archæological expeditions will be possible in the Summer Term.

In conclusion, the Section begs to thank Mr. Bloxam for his invaluable aid and direction.

H. BASHALL, Head of Section.
G. JONES.

Geological Section for 1876.

[Omitted by oversight from last Report.]

Upper Lias fossils from Kilsby Tunnel, presented by H. N. Hutchinson, (O.R.)

Inoceramus dubius (6 specimens), Pinna sp. (3 specimens), Modiola scalprum (2 specimens), Trochus imbricatus (2 specimens), Unicardium cardioides (3 specimens), Myacites sp. (2 specimens), Pecten sublævis, Plicatula spinosa, Rhynconella sp., Gryphæa incurva (dorsal valve), Pleuromya unionides (2 specimens), Ammonites Henleyi (2 specimens), Ammonites Ibex, Belemnites and phragmocones, Serpula, claw of crab.

The prizes for geological collections were awarded as follows.

1. G. Jones 2. { F. Arnold / T. B. Oldham }

The following is the list of the Prize collection.

King's Newnham: Ammonites sp.

Newbold: Vertebrae of Icthyosaurus, Small ribs, Pentacrinus Briareus, P. basaltiformis, Lima gigantea, Gryphæa incurva, Rhynconella sp., Unicardium cardioides (?), Ostrea sp., Ammonites angulatus, A. Bucklandi, A. semicostatus, casts of Pleurotomaria.

Victoria Works: Vertebrae of Teleosaurus, Vertebrae of Icthyosaurus, rib of saurian, Humerus (?) of saurian, Coprolites, Lignite, Lima gigantea, L. rigida, Avicula sp., Ostrea liassica unattached valve, Lignitic mud, casts of shells, pyritized, Ammonites Bucklandi, A. Conybeari, Ammonites sp., Nautilus sp., Pentacrinus sp.

Lower New Bilton, (Parnell's Pit): Ammonites (?) amaltheus, A. angulatus, A. semicostatus, Pleurotomaria sp., Avicula, Pecten, Gryphæa cymbium, Gryphæa incurva, Cidaris' spines.

Lower New Bilton, (Pinfold's Pit): Ammonites Bucklandi (var.), A. semicostatus, Gryphæa incurva, Avicula, Lima gigantea, Lignite.

Newbold Road: Lima gigantea, Ammonites angulatus.

Upper New Bilton, (Bromwich's Pit): Rhynconella sp., Gryphæa.

Bilton Road: Gryphæa incurva, Pyritized Ostrea ? Lignite.

Dunchurch Road: Ammonites Bucklandi, A. Conybeari, A. Dudresii, Ammonites sp., Arca truncata, Astarte, Lima pectinoides, Pecten, Ammonites semicostatus.

Upper Hillmorton: Ammonites Birchii, A. ophioides, A. semicostatus, A. oxynotus, Nautilus sp., Trochus, Pecten, Hippopodium ponderosum, Rhynconella sp., Unicardium sp., Montlivaltia rugosa, Pentacrinites Briareus.

Barby Hill, (by Canal): Ammonites sp., Unicardium cardioides, Gryphæa incurva.

DRIFT.

Church Lawford: Ostrea, Carbonate of Lime (crystallized), Striated blocks of Limestone.

Long Lawford: Bone, small piece.

Canal Cutting between Newbold and Brownsover: Ammonites communis, Oolitic pebbles, Striated Limestone.

Dunchurch Road Pit: Ammonites communis.

Lower New Bilton: Echinus in flint.

Plain round Butts (Valley of Lilbourne-on-Avon): Gryphæa incurva, Striated chalk pebbles.

Upper New Bilton: Coral rag (?).

In December, H. Keeping, Esq., Curator of the Woodwardian Museum at Cambridge, came down to overlook and arrange our local collection in the Arnold Library. He also partly arranged the general collection, with the assistance of several members of the Society, and notably of H. N. Hutchinson (O.R.)

During the year, the pits on the Dunchurch Road have been abandoned, and Mr. Pinfold has started some new pits beside the old New Bilton ones, which are very fossiliferous.

Dec. 1876. T. B. OLDHAM.

Geological Section for 1877.

The following fossils have been presented to the Arnold Library collections. Annelids, from Church Lawford, by W. Sellar. Annelids, from King's Newnham, by T. B. Oldham. Bone from jaw of Icthyosaurus platyodon; coracoid of Icthyosaurus; ischium of Plesiosaurus; jaw of Teleosaurus (probably a new species); and jaw of Icthyosaurus, from Victoria Works; a series of bones of Icthyosaurus containing a fine basi-occipital and basi-sphenoid from Newbold; Nautilus striatus; ink-bag and upper structure of Belemnite; Belemnite with ink-bag; Belemnites longissimus, from Lyme Regis, by J. M. Wilson, Esq. Series of Ammonites; series of Littorina; Crustacean Cepalothorax (?), from Hillmorton, by H. N. Hutchinson, (O.R.) Nautilus striatus, Hillmorton, by O. Openshaw. Modiola cuneata, Hillmorton, by S. C. Satterthwaite. Dinosaurus, 5 dermal scutes of; Dinosaurus, vertebra of; Plesiosaurus, 3 vertebræ of; Plesiosaurus, 2 phalanges of; Polyptychodon, tooth of; Icthyosaurus, 2 teeth of; Icthyosaurus, phalanx of; Edaphodon, 4 palatal teeth of; 3 crabs; claw of crab; Fish palate and lobster, from Cambridge Greensand, by W. Bateson. Ammonites Henleyi, Ammonites sp., Hippopodium ponderosum, Cardinia Listeri, Icthyosaurus vertebra, from the Lower Lias, Cheltenham; Cardinia sp., Lower Lias, Chosen Hill; Corbula sp., Middle Lias, near Cheltenham; specimens of ferns, Lower Lias, Leckhampton Hill; Arca sp., Upper Lias, Tewkesbury; piece of Rhætic bone bed, Tewkesbury; Modiola plicata, Terebratula simplex, Terebratula plicata, Diadema depressum, Stomachina sp., Perna rugosa, Pholodomya Murchisoniæ, Gryphæa dilatata, Trigonia formosa, Hemisphericus depressus, Echinus pygaster, Microsalenia Lycettii, Cidaris Fowleri, Fish palate, from Oolite near Cheltenham; crab from London clay, Isle of Sheppey, by L. Cumming, Esq. Potamomya plana, Cytherea suberycinoides, Voluta calva, Pectunculus sp., Ostrea flabellula, Nummulites, Turritella imbricataria, Phorus agglutinans, Voluta athletis, Voluta nodosa, Cardita Brogniarti, Cardita planicosta, Cyrena obovata, Ditrupa plana, from the Bracklesham beds, Isle of Wight; Limnea lenta, Osborne beds, Isle of Wight; Planorbis enomphalus, Cyrena obovata, Fish scale, Natica Haughtonensis, Hydrobia polita, Cerithium concavum, Ostrea vectensis, Buccinum labiatum, Nucula sp., Cytherea incrassata, Cerithium trigonatum, Melanopsis subfusiformis, from the Headon beds, Isle of Wight; Hydrobia Chastelli, Cyrena striata, from Hempstead beds, Isle of Wight; Ostrea Bellovacina, Oldhaven beds, Chiselhurst; Planorbis obtusus, Limnea longiscata, from Bembridge beds, Isle of Wight; Fermicularia, from Under-cliff, St. Michael's, Isle of Wight; Inoceramus sulcatus, Belemnites minimus, Ammonites Goodhallii, from

Gault, near Whitehill, Isle of Wight; Coscinopora, Upper Chalk, Whitecliff, Isle of Wight; Oyster (? exogyra) bed, Punfield beds, Sandown; Beef, (fibrous carbonate of lime), Atherfield Point, Isle of Wight; Cyrena media, Punfield beds, Atherfield Point, Isle of Wight; Paludina (?) Sussexensis, Wealden, Sandown, Isle of Wight; Pecten orbicularis, Exogyra conica, Upper Greensand, Isle of Wight; Gervilia anceps, Cracker beds, Atherfield Point; Serpularia, Gervillia alæformis, Corbis corrugata, Holocystis elegans, Exogyra sinuata, Rhynconella sp., Terebratula sella, Lower Greensand, Isle of Wight; Turrilites costatus, Ammonites varians, Lower Chalk, near Ventnor; Inoceramus sp., Lima spinosa, Ananchytes ovatus, Eschara (?) in Echinoderm, Ventriculites radiatus, Ocellaria, Crania Parisiensis, Terebratula semiglobosa, T. carnea, Spongia globosa, from Upper Chalk, Caterham Junction, Surrey; Spongia ramosa, Chalk, Bromley, Kent; Micraster coranguinum, Diancora striata, Crania, sp., Serpularia, Spongia plana, Upper Chalk, Purley, Kent; Inoceramus Cuvieri, Chalk, Henley, Kent; Panopæa plicata, Nutfield, Surrey; Annelid tracks, summit of Ben More, by R. D. Oldham, (O.R.)

Note on the White Lias in the neighbourhood of Rugby, by T. B. Oldham and G. Jones.

The White Lias is exposed in King's Newnham Limeworks, in Long Lawford Limeworks, in Church Lawford Railway Cutting and Church Lawford Brook, in the Limeworks at Limestone Hall, near Church Lawford, in Limeworks at Birdingbury, and in the Stretton-on-Dunsmore Limeworks. It is from 6 ft. to 8 ft. in thickness, the upper part being a shelly limestone divided by partings of dark clay, the lower part being one firm band. It is now only burnt for lime, but has been used for building purposes. Two petrifying springs, one at Stretton-on-Dunsmore the other at Limestone Hall, and the celebrated Newnham spring, come from its base. Exclusive of those fossils mentioned in E. Cleminshaw's lists, (see Rep. R. S. N. H. S. 1867 and 1868,) we have found the following in the White Lias.

Cerithium sp.?	King's Newnham.
Tornatella or Cylindrites	King's Newnham.
Avicula inæquivalvis, junior	Church Lawford Cutting, King's Newnham, Limestone Hall, and Stretton-on-Dunsmore.
Cardium truncatum	King's Newnham.
Modiola minima	Stretton-on-Dunsmore, and King's Newnham.
Modiola Psylonoti	King's Newnham.
Lima antiquata	King's Newnham, and Stretton-on-Dunsmore.
Placunanomia alpina	King's Newnham, and Stretton-on-Dunsmore.
Plicatula spinosa	King's Newnham.
Plicatula intusstriata	King's Newnham, Limestone Hall, and Stretton-on-Dunsmore.
Cidaris sp. (spines of)	King's Newnham, Limestone Hall, Long Lawford, and Stretton-on-Dunsmore.
Ophiolepis Damesii*	King's Newnham.
Annelid tubes	King's Newnham, Long Lawford, Limestone Hall, Church Lawford, (Railway Cutting and Brook), and Stretton-on-Dunsmore.

All these fossils are named on the authority of R. Etheridge, Esq., and will be placed in the Local Collection in the Arnold Library.

* This fossil was first found in this locality by H. J. Elsee in Nov., 1877. At the request of Mr. Etheridge, one of the specimens was presented to the Jermyn Street Museum.

The first prize for a Local Geological Collection was this year awarded to T. B. Oldham.

The following is a list of the prize collection.

KING'S NEWNHAM. 1, *White Lias*. Cerithium sp. ?, Tornatella or Cylindrites, Avicula inæquivalvis, junior, Cardium truncatum, Modiola minima, Modiola psylonoti, Lima antiquata, Placunanonia Alpina, Plicatula spinosa, Plicatula intusstriata, Cidaris spines, Ophiolepis Damesii, Annelids.

2, *Lower Lias*. Ammonites planorbis, Gryphæa incurva, Cidaris spines, Pecten sp.

LONG LAWFORD. 1, *White Lias*. Annelids.

2, *Lower Lias*. Ammonites planorbis, Cidaris spines, Pecten sp., Ostrea arietis, Icthyosaurus, bone of jaw of.

CHURCH LAWFORD RAILWAY CUTTING. 1, *White Lias*. Avicula inæquivalvis, junior, Annelids.

2, *Lower Lias*. Cidaris spines, Ammonites planorbis.

LIMESTONE HALL. 1, *White Lias*. Avicula inæquivalvis, junior, Annelids, Fish scales.

2, *Lower Lias*. Ammonites planorbis, Cidaris spines.

STRETTON-ON-DUNSMORE. *White Lias*. Cerithium sp., Avicula inæquivalvis, junior, Modiola minima, Lima antiquata, Plicatula spinosa, Plicatula intusstriata, Cidaris spines, Annelids.

NEWBOLD. *Lower Lias Limestone and Clay*. Vertebræ, ribs, teeth, paddle bones, humerus and basi-sphenoid of Icthyosaurus, Vertebra of Teleosaurus, Fish scales, Ammonites angulatus, A. Conybeari, A. Bucklandi, A. semicostatus, Turritella sp., Littorina sp., Pleurotomaria (cast of), Rhynconella variabilis, Avicula sp. (?), Gryphæa incurva, G. cymbium, Lima gigantea, Ostrea liassica, Pecten, Pentacrinus Briareus, Cidaris spines, Coral sp., Lignite.

NEWBOLD OLD WORKS, *(Near Holbrook Grange)*. Ammonites angulatus, Rhynconella variabilis, Lima Hermanni, Lima gigantea, Modiola minima, Ostrea, Myacites sp., Cidaris spines, Pentacrinus sp.

HARBURY. Ammonites angulatus, A. semicostatus, Gryphæa incurva, Lima gigantea, Ostrea on Ammonite, Pentacrinus sp., Cidaris spines, Pecten sp.

VICTORIA WORKS. Icthyosaurus, ribs and vertebræ of, Ammonites Bucklandi, A. semicostatus, Ammonites sp. (?), Rhynconella variabilis, Avicula papyria, Avicula inæquivalvis, Gryphæa incurva, Lima gigantea, Ostrea liassica, Spondylus sp., Pentacrinus sp.

NEW BILTON. Nautilus striatus, Ammonites angulatus, A semicostatus, A. armatus, Actæonina fragilis, Pleurotomaria Anglica, Turritella sp., Littorina sp., Rhynconella variabilis, Arca Stricklandi or Oxynoti, Avicula inæquivalvis, Gryphæa incurva, Lima gigantea, Lima pectinoides, Modiola minima, Pentacrinus sp., Cidaris spines.

RUGBY. Cephalothorax of crustacean ?, Ammonites Bucklandi, A. Dudresii, A. sauzeanus, Turritella, Littorina, Rhynconella variabilis, Gryphæa incurva, Lima pectinoides, Modiola minima, Unicardium cardioides, Pentacrinus sp., Cidaris spines.

UPPER HILLMORTON. Icthyosaurus, basi-occipital and vertebra of, Fish scales, Belemnites elongatus, Belemnites acutus, Nautilus striatus, Ammonites angulatus, A. Birchii, A. armatus, A. Conybeari, A. Guibalianus, A. Johnstoni, A. ophioides, A. oxynotus, A. semicostatus, A. candidus, A. raricostatus, A. capricornis, Actæonina fragilis, Littorina allied to Littorina fidia, Rotella rotelliformis, Turritella, Discina reflexa,

Rhynconella variabilis, Arca Stricklandi, Avicula inæquivalvis, Cardinia Listeri, Gryphæa incurva, Gryphæa cymbium, Hippopodium ponderosum, Leda complanata, Lima gigantea, Lima rigida, Lima pectinoides, Modiola scalprum, Pholadomya gibbosa, Plicatula spinosa, Pinna diluviana, Pecten textorius, Unicardium cardioides, Pentacrinus Briareus, Cidaris spines, Montlivaltia rugosa, Serpula capitata, Pyritized wood.

KITTENTHORPE. Belemnites elongatus, Ammonites Birchii, Littorina, Gryphæa incurva, Lima pectinoides, Plicatula spinosa, Unicardium cardioides, Cidaris spines, Montlivaltia rugosa.

LOWER HILLMORTON. Ammonites Birchii, A. Guibalianus, A. candidus, A. sauzeanus, Littorina sp., Rhynconella variabilis, Gryphæa incurva, Pentacrinus sp.

KILSBY. Rhynconella variabilis, Lima pectinoides, Unicardium cardioides, Inoceramus dubius, Cidaris spines, Serpula capitata.

DRIFT.

BROWNSOVER DRIFT. Ammonites biplex, A. bifrons, A. communis, Dentalium, Belemnites, Gryphæa dilatata, G. incurva, Cardinia crassissima, Inoceramus in flint, Trigonia sp., Echinus in chalk, Terebratula fimbria, Avicula inæquivalvis, Arca, Pentacrinite, Littorina (cast of).

LOWER HILLMORTON BALLAST PITS. Ammonites semicostatus, Gryphæa dilatata, Pentacrinite, Spongia.

ALSO Inoceramus sp. in flint, Gravel drift, Long Lawford Limeworks. Productus sp., C.L., Church Lawford Brook. Modiola imbricata, Inferior Oolite, Church Lawford Cutting. Coral in flint, Easenhall Railway Cutting. Teeth and cervical vertebræ of deer, Little Lawford Mill, and Ammonites communis, drift at Rugby Brickworks.

LIST OF RUGBY FOSSILS.

NAME OF FOSSIL.	KING'S NEWNHAM. Rhætic.	KING'S NEWNHAM. Low Lias.	CHURCH LAWFORD. Rhætic.	CHURCH LAWFORD. Low Lias.	LONG LAWFORD. Rhætic.	LONG LAWFORD. Low Lias.	STRETTON-ON-DUNSMORE. Rhætic.	STRETTON-ON-DUNSMORE. Low Lias.	NEWBOLD.	VICTORIA.	NEW BILTON.	RUGBY.	UPPER HILLMORTON.	LOWER HILLMORTON.	KILSBY.	OTHER LOCALITIES.
REPTILIA.																
Icthyosaurus campylodon									—							
tenuirostris									—							
communis						—			—	—			—			
vertebræ of sp.	—	—				—					—	—				
Plesiosaurus sp.		—				—			—	—						
Teleosaurus sp.										·						
PISCES.																
Aechmodus sp.										·						
Hybodus reticulatus																
Pholidophorus (?)																
Fish scales		—	—				—			·			—			

Name of Fossil.	King's Newnham. Rhætic.	King's Newnham. Low Lias.	Church Lawford. Rhætic.	Church Lawford. Low Lias.	Long Lawford. Rhætic.	Long Lawford. Low Lias.	Stretton-on-Dunsmore. Rhætic.	Stretton-on-Dunsmore. Low Lias.	Newbold.	Victoria.	New Bilton.	Rugby.	Upper Hillmorton.	Lower Hillmorton.	Kilsby.	Other Localities.
MOLLUSCA.																
CEPHALOPODA.																
Belemnites acutus													—		—	
elongatus									—				—	—	—	Kittenthorpe.
obtusus													—			
Nautilus striatus										—	—	—	—			
lineatus										—	—	—				
Ammonites angulatus									—	—	—	—	—			Toft, Harbury, Newbold [Old Works.
armatus									—	—	—	—	—	—		
armatus densinodus													—			
amaltheus ?													—			
Birchii													—	—		Kittenthorpe.
bisulcatus		—														
Bonardi											—					
Brookii										—					—	Railway Cutting, Clifton [Road.
Bucklandi									—	—	—	—	—			Toft.
Catenatus									—	—	—	—	—			
Conybeari									—	—	—		—			
communis raricostatus												—	—			
cornucopia															—	
candidus													—			
capricornis													—			
Dudresii										—	—	—				Toft.
forficatus													—			
Guibalianus													—	—		
Henleyi												—	—		—	
halecis												—	—			
heterophyllus									—				—			
Hildensis															—	
Ibex															—	
Johnstoni		—											—			
maculatus															—	
maugenisti												—	—			
obliquistriatus									—							
obtusus									—		—					
oxynotus									—	—	—		—			
ophioides													—			
planorbis		—		—				—								
planicostatus											—		—		—	
rotiformis													—			
raricostatus													—			
semicostatus									—	—	—	—	—	—		Harbury.
sauzeanus											—	—	—	—		
Turneri												—	—			

Name of Fossil.	King's Newnham. Rhætic.	King's Newnham. Low Lias.	Church Lawford. Rhætic.	Church Lawford. Low Lias.	Long Lawford. Rhætic.	Long Lawford. Low Lias.	Stretton-on-Dunsmore. Rhætic.	Stretton-on-Dunsmore. Low Lias.	Newbold.	Victoria.	New Bilton.	Rugby.	Upper Hillmorton.	Lower Hillmorton.	Kilsby.	Other Localities.
Ammonites variocostatus																Locality uncertain.
densinodus													—			
ziphus													—			
GASTEROPODA.																
Actæonina fragilis											—	—	—			
Cerithium sp.	—		—				—									
Chemnitzia																[Kittenthorpe.
Littorina sp.																Newbold Old Works.
Pleurotomaria Anglica																Newbold Old Works.
depressa																[Toft.
expansa																
similis																
Rotella lobelliformis																
rotelliformis																
Scalaria liassica																
Tornatella sp.							—									
Turritella sp.																
BRACHIOPODA.																
Discina Holdeni																
reflexa																
Lingula Beanii																[Old Works.
Rhynconella variabilis																Kittenthorpe, Newbold
Terebratula numismalis																
CONCHIFERA.																
Arca truncata																
tunicata																
punctata																
Stricklandi																
Oxynoti																
Avicula decussata																
papyria																
sinemuriensis																
Inæquivalvis																
inæquivalvis, junior					—		—									
Cardinia ovalis						—										
Listeri						—										
Cardium truncatum																
Gervillia opifex																
Gryphæa incurva																Kittenthorpe, Harbury.
cymbium																Harbury.
Goniomya rhombifera																

Name of Fossil.	King's Newnham. Rhætic.	King's Newnham. Low Lias.	Church Lawford. Rhætic.	Church Lawford. Low Lias.	Long Lawford. Rhætic.	Long Lawford. Low Lias.	Stretton-on-Dunsmore. Rhætic.	Stretton-on-Dunsmore. Low Lias.	Newbold.	Victoria.	New Bilton.	Rugby.	Upper Hillmorton.	Lower Hillmorton.	Kilsby.	Other Localities.
Inoceramus dubius															—	
Leda complanata											—	—	—			
rostralis												—				
caudata													—			
Lima gigantea									—	—	—	—	—			
punctata													—	—		
Hermanni									—							Newbold Old Works.
rigida											—		—			
antiquata	—						—									
pectinoides									—	—	—	—	—	—	—	Kittenthorpe.
Lucina sp.	—															
Modiola cuneata													—		—	
Hillana										—	—	—				
minima	—				—		—				—	—	—			Newbold Old Works.
Psylonoti	—															
scalprum													—		—	
Myacites unionides													—		—	
musculoides	—								—							
longissimus													—			
Ostrea liassica					—				—	—						
laniscula											—					
arietis						—			—				—			
Panopæa elongata																
Pecten æquivalvis												—	—		—	
textorius											—		—		—	
sublævis															—	
Pecten sp.				—		—		—	—	—	—	—	—	—	—	Harbury.
Pinna diluviana												—	—	—	—	
Pholadomya gibbosa													—	—		
ambigua													—	—		
Pleuromya unionides															—	
Placunanomia alpina							—									
Plicatula spinosa							—						—		—	Kittenthorpe.
intusstriata			—				—									
Spondylus sp.										—						
Unicardium cardioides									—		—	—	—		—	Kittenthorpe.
CRUSTACEA.																
Cephalothorax (?)												—	—			
Cypris liassica																
Cypris sp.	—									—						
Crustacean remains									—	—	—	—	—		—	
ARTICULATA.																
ANNELIDA.																
Serpula capitata													—		—	

Name of Fossil.	King's Newnham. Rhætic.	King's Newnham. Low Lias.	Church Lawford. Rhætic.	Church Lawford. Low Lias.	Long Lawford. Rhætic.	Long Lawford. Low Lias.	Stretton-on-Dunsmore. Rhætic.	Stretton-on-Dunsmore. Low Lias.	Newbold.	Victoria.	New Bilton.					
Annelids	—		—		—		—									
ECHINODERMATA.																
Cidaris Tomesii	—															
Cidaris sp., spines of	—	—	—	—	—	—	—	—	—	—	—					
Hemipedina sp.	—															
Ophiolepis Damesii	—															
Pentacrinus Briareus									—	—	—	—	—	—	—	Harbury.
basaltiformis												—	—			
robustus									—							
ZOOPHYTA.																
Montlivaltia rugosa													—			Kittenthorpe.
Coral	—								—							

In this list I have applied the more correct names of 'Long Lawford' and 'Newbold Old Works' respectively to the localities called 'Church Lawford' and 'Near Holbrook Grange' in E. Cleminshaw's lists. As now given, it is an extension of those published in the Reports of the Society for 1867-1868. The originals of many of the species cannot now be obtained for re-examination, and the names applied to them are given entirely as the authority of the original lists. Of the more recent additions, all the specimens have been named by R. Etheridge, Esq., Royal School of Mines, Jermyn Street, London, for whose kind assistance I am much indebted.

T. B. Oldham.

December, 1877.

Entomological Section.

We are sorry to notice so few observers this year, and in consequence a smaller observation list than last year. The following is the record of appearances, compared, where possible, with the previous year:—

The observers are designated by the following initials:—A. S., A. Sidgwick; J. E. M., J. E. Marsh; J. L., J. Lea.

Observer.	Name.	1877.	1876.
A. S.	S. Illunaria ...	... Feb. 5 ...	—
"	A. Aescularia ...	... " 12 ...	—
"	C. Ligniperda (larva)	... May 13 ...	—
"	M. Subtristata ...	... June 4 ...	—

Observer.	Name.	1877.	1876.
J. E. M.	S. Clathrata ...	... June 5	... June 4
"	M. Montanata ...	... " 9	... " 10
"	P. Gamma ...	... " 9	... —
"	C. Ferrugata ...	... " 9	... May 20
"	C. Unidentaria ...	... " 9	... " 20
"	A. Cardamines ...	... " 9	... " 28
"	M. Brassicae ...	... " 9	... June 5
A. S.	H. Lupulinus ...	... " 10	... April 21
J. E. M.	A. Menthastri ...	... " 11	... June 19
"	M. Fluctuata ...	... " 11	... April 30
"	C. Exanthemaria ...	... " 11	... —
"	A. Polydactyla ...	... " 11	... June 19
J. L.	C. Edusa ...	... " 11	... —
"	E. Decolorata ...	... " 11	... —
"	C. Cardui ...	... " 11	... —
J. E. M.	D. Vinula (ova) ...	... " 13	... —
"	T. Alveolus ...	... " 15	... —
"	P. Hamula ...	... " 16	... —
"	D. Pudibunda ...	... " 18	... —
J. L.	P. Alexis ...	... " 18	... June 10
"	V. Atalanta ...	... " 18	... —
A. S.	E. Bipunctaria ...	... " 20	... —
"	S. Tiliae ...	... " 21	... May 28
J. E. M.	S. Populi (ova) ...	... " 23	... —
"	C. Bilineata ...	... " 23	... June 10
J. L.	C. Pusaria ...	... " 23	... July 8
"	P. Marginata ...	... " 23	... " 11
J. E. M.	C. Corylata ...	... " 24	... June 11
"	C. Phloeas ...	... " 24	... —
"	D. Caeruleocephala (larva) ...	... " 24	... —
"	H. Humuli ...	... " 26	... June 14
"	I. Lactearia ...	... " 26	... —
"	M. Ocellata ...	... " 28	... July 17
A. S.	T. Pruniana ...	... " 29	... —
J. L.	L. Pectinitaria ...	... " 30	... June 27
"	H. Janira ...	... " 30	... " 10
"	P. Bucephala ...	... " 30	... May 20
A. S.	S. Olivalis ...	... July 2	... June 20
J. E. M.	A. Exclamationis ...	... " 3	... " 26
"	X. Polyodon ...	... " 3	... " 11
"	S. Ocellatus ...	... " 3	... —
A. S.	T. Tipuliformis ...	... " 4	... —
"	T. Forsterana ...	... " 4	... July 12
"	A. Aversata ...	... " 4	... —
J. E. M.	T. Viridana ...	... " 4	... July 8
"	A. Scutulata ...	... " 4	... —
A. S.	P. Dolobraria ...	... " 6	... June 1
"	E. Punctaria ...	... " 7	... —
"	P. Bajularia ...	... " 7	... —
"	P. Prasinana ...	... " 7	... —
"	M. Miniata ...	... " 7	... —
"	P. Nebulosa ...	... " 7	... —
"	T. Ribeana ...	... " 7	... —
"	B. Amataria ...	... " 7	... July 9
"	A. Psi	... " 11	... June 24
J. L.	S. Ligustri ...	... " 11	... —
A. S.	C. Bergmanniana...	... " 12	... —
J. L.	A. Oculea ...	... " 12	... —

Observer.	Name.	1877.	1876.
J. L.	C. Pyraliata ...	... July 12	... July 14
"	L. Fulvata ...	... " 12	... " 18
"	P. Cytisaria ...	... " 12	... —
"	H. Thymiaria ...	... " 12	... July 11
"	B. Perla ...	... " 13	... " 11
A. S.	A. Heliophobus ...	... " 18	... —
J. E. M.	C. Umbratica ...	... " 18	... July 2
"	H. Tithonus ...	... " 18	... " 15
"	M. Unangulata ...	... " 18	... " 10
"	M. Rubiginata ...	... " 18	... —
"	M. Margaritaria ...	... " 18	... July 19
J. L.	A. Imitaria ...	... " 18	... —
A. S.	A. Grossulariata ...	... " 19	... —
"	C. Cubicularis ...	... " 24	... June 28
"	S. Verticalis ...	... " 24	... —
"	L. Impura ...	... " 24	... —
"	T. Holmiana ...	... " 24	... —
"	H. Vanaria ...	... Aug. 4	... —
"	O. Sambucaria ...	... " 4	... July 18
J. E. M.	N. Ziczac ...	... " 20	... —
"	C. Nupta ...	... " 23	... —
"	P. Gamma ...	... Sept. 22	... —
"	S. Lubricipeda ...	... " 22	... June 14
A. S.	S. Filiae (larva) ...	... " 22	... —
"	A. Betularia (larva)	... " 22	... —
"	M. Persicariae (larva)	... " 22	... —
"	A. Psi (larva) ...	... " 24	... —
"	S. Populi (larva) ...	... " 25	... —
"	E. Lucipara (larva)	... " 26	... —
J. L.	G. Libatria ...	... Oct. 1	... —
"	Y. Elutata ...	... " 2	... July 1
"	O. Antiqua ...	... " 14	... —
A. S.	E. Apiciaria ...	... " 24	... —
J. L.	C. Brumata ...	... Nov. 12	... —
A. S.	P. Meticulosa ...	... " 14	... Sept 24

The object of this list is to shew not only what insects are to be obtained in the neighbourhood of Rugby, but at what time they are to be found. No trouble is needed by an observer: a list, obtained from the President, of most of the insects likely to be observed, and a pencil, is all that is wanted. It is by keeping a list of observations that great help can be rendered to the Society by almost anybody.

We subjoin a list of insects bred by the President and J. E. Marsh during the last season, with their dates:—

A. S.	Feb. 6	D. Pudibunda	A. S.	June 12	M. Brassicae
"	" 25	T. Stabilis	J. E. M.	July 4	D. Furcula
"	" 26	T. Cruda	A. S.	" 6	A. Exclamationis
"	Mar. 3	T. Instabilis	"	" 10	C. Bergmanniana
"	Apl. 14	P. Bucephala	"	" 20	C. Xylostella
"	May 23	S. Lubricipeda	"	" 23	L. Salicis
"	" 25	S. Tiliae	J. E. M.	Aug. 10	C. Curtula
"	June 9	A. Betularia	"	" 20	N. Ziczac
"	" 12	M. Persicariae	"	" 23	C. Nupta

The following note was sent by W. C. Marshall to the President:—

'I have just seen your paper on Persicariae in the Report, and it prompts me to write on some other colour variations in Lepidopterous

larvae. Have you ever reared any of the Notodontidae that feed up in the autumn? Dromedarius is very interesting during its later stages at which it arrives. At the time when the birch trees, on which it feeds, are changing colour, it, like its food, goes into autumn tints, turning the most beautiful yellows and reds. This change, as far as my experience goes, is invariable, both with larvae in captivity and at large. I think the theory of protective resemblance has a strong claim in this case. I do not see why the larvae should not inherit a colour, varying with the stages of its development, just as the larva of Pavonia Minor undoubtedly does. Camelina also often, though I think not always, changes its colour at its last moult (I think only the last), being flushed with a beautiful pink, blending strangely with the general green colour, sometimes one, sometimes the other predominating. And this, too, comes at the time that the food plant is changing colour. These larvae feed on the still green leaves, although they take advantage of their colour to rest against the stems like the crumpled turned leaves on the same sprigs. Of course I suppose it is possible that the changes in the leaf, which bring about the difference in colour, may be so far advanced in the leaves which still remain as directly to affect the colour of the larvae feeding on them. It is worth observing that the larvae of Camelita, which feed up earlier on birch before the leaves have begun to show any signs at all of changing colour, remain green to the last. I have reared Ziczac and Plumigera, but have not observed them closely enough to speak with certainty about their colour. On connection with this subject, I think it would be very interesting to observe Pavonia Minor. I well remember the first specimen I ever got; it was the first larva I reared, and it received a greal deal of care and attention. It was found on a Cumberland Moor, and I was much puzzled with the differences between my larva and that figured in the book in which I identified it: and not a little indignant at what I imagined to be the inaccuracy of the book. I took it through Scotland to Belfast, and from there round the North of Ireland to Horn Head, where it escaped, but was captured at the bar of the inn (he was fond of drink, and would take drops of water off your finger): from thence it went to Enniskillen and Dublin, and underwent his final moult at Limerick: where to my greatest delight he assumed the pattern shown in my book, and turned to a chrysalis, emerging a fine male next spring at Leeds. What I want to know is, Are the various marked changes of appearance in any way corresponding to the stages of the common heather and its flowering, and likely to be protective? I think I have noticed that when feeding on oak, bright green is much more predominant in the colour of the larvae than when it is on heather.'

Note by A. Sidgwick on Persicariae.

It may be in the recollection of some members, that last year at this time I read a paper on the larvae of M. Persicariae, chiefly with reference to their variation of colour. Some are green, and some are brown: and it occurred to me that the colour might be affected by the circumstances in which the larva is placed. I have this year taken accurate statistics from the first of the larvae of this insect which I have collected: and of the plants on which I have taken them. I find the following results:—On geranium, 31 green, 5 brown; on ivy, 4 green, 10 brown; violet, no green, 5 brown; chrysanthemum, no green, 1 brown.

One striking result of noticing the colours I find to be this, that one

confidently expects to find the larva if it is on an exposed plant, to be on its own colour. Over and over again I have found a larva on geranium exactly the colour of the plant.

The following is the list of additions to the collection and to the local list of Lepidoptera: those marked with an asterisk (*) are new to the collection:—

Presented by Rev. H. Williams, Croxton Thetford.

Calocampa Exoleta, 2	Galleria Mellonella, 4
Leucania Conigera, 2	Cloephora Prasinata, 2
Acidalia Rubricata, 3	

Added to Collection.

Dictyopterus Holmiana	*Erastria Fuscula
Antithesia Pruniana	*Daplidice (foreign specimen)
Tortrix Ribeana, 3	*Euphorbiae (A. S.)
Lozotaenia Rosana	Cardui
*Phibalocera Quercana	*Chrysidiforme (A. S.)
Pericallia Syringaria	*Aenestis Quadra (A. S.)
Trochilium Tipuliforme	Smerinthus Populi
Biston Betularia (dark)	Stilpnotia Salicis
Dasychira Pudibunda	*Tethea Subtusa (A. S.)
*Chloephora Prasinana	*Dianthaecia Albimacula
*Craesia Bergmanniana	Metrocampa Margaritaria
*P. Bajularia	*Ligdia Adustaba
Iodis Lactearia	*Acidalia Scutulata
*Polia Nebulosa	Cidaria Olivaria
Miltochrista Miniata	*Stenopteryx Hybridalis (A. S.)
Scopula Prunalis	*Scopula Ferrugalis (A. S.)
*Cerostoma Xylostella	*Ebulea Verbascalis (A. S.)
*Pterophorus Fuscus	*Gnophos Obscurata
„ Pterodactylus	*Acidalia Contiguaria
* „ Bipunctidactylus	

Added to Local List.

D. Holmiana	Polia Nebulosa
P. Quercana	Pterophorus Fuscus
Chloephora Prasinana	Cerostoma Xylostella
Craesia Bergmanniana	Erastria Fuscula
Phorodesma Bajularia	Metrocampa Margaritaria

Zoological Section.

There has been very little work done in this Section this year, but we hope to get more before our next Report.

The following is the list of the Rooks' Nests in the Close, as long as they have been observed:—

1873	..	89
1874	..	90
1875	..	109
1876	..	107
1877	..	73

The great falling off is due to circumstances not yet fully explained. Attention was called to the subject in a letter in the *Meteor* of April 2,

by 'Cosmopolitan,' who pointed out that there had been a large secession to the Bilton Road, for reasons unknown, but which he suspected had some reference to the use of the instrument known as a 'tweaker.' This secession began in 1873 with one nest: and in the four following years there were on the Bilton Road three, four, seven, and nine nests respectively. This year, 1877, the nests amounted to no less than 36. There is, however, reason to hope that 'Cosmopolitan' is wrong in attributing the falling off to tweakers.

The following is a list of birds observed in the neighbourhood by E. M. D. Whatman. The list was made out, strictly speaking, after the Report was in the press, *i.e.* in 1878: but as it will be of value for observers this year, we venture to publish it in our Report for 1877.

Blackcap
Blackbird
Bullfinch
Bunting
Black-headed Bunting
Cock Bunting
Chaffinch
Chiffchaff
Coot
Creeper
Crow
Cuckoo
Ringdove
Turtle Dove
Wild Duck
Flycatcher, Spotted
Flycatcher, Pied
Fieldfare (migrates)
Goldfinch
Greenfinch
Hawfinch
Sparrow Hawk
Heron
Jackdaw
Jay
Kestrel
Kingfisher
Lapwing
Skylark
Woodlark
Titlark
Brown Linnet
Magpie
Martin
Sand Martin
Moorhen
Nightingale
Nightjar
Nuthatch
Barn Owl
Tawny Owl
Partridge (Common)
Partridge (Red Leg)
Pheasant
Wood Pigeon
Rock Pigeon
Tree Pipit
Meadow Pipit
Landrail
Redpoll
Redstart
Redwing (migrates to Norway)
Golden-crested Wren
Robin
Rook
Red-backed Shrike
Hedge Sparrow
Tree Sparrow
House Sparrow
Starling
Stonechat
Swallow
Swan (Tame)
Swift
Snipe (Common)
Thrush (Common)
Thrush (Missel)
Great Tit
Blue Tit
Cole Tit
Marsh Tit
Longtailed Tit
Wagtail (Pied)
Wagtail (Yellow)
Warbler (Sedge)
Warbler (Wood)
Warbler (Garden)
Wheatear
Winchat
Whitethroat
Lesser Whitethroat
Green Woodpecker
Woodcock
Wren
Wren (Willow)
Wryneck
Yellowhammer

(87 species.)

Botanical Section.

The work of this Section has again fallen for the season almost entirely on two or three observers, with the inevitable result that the number of flowers observed has been small, and many of them have not been caught when first open. Our list of new plants and new localities is at least up to the average: but in this we have been much assisted by our old friend, H. W. Trott (O.R.), and by A. P. Bosanquet, a diligent young botanist, who, unfortunately for the Section, left at Christmas.

The following is the list of new plants and localities for the season:—

Linaria cymballaria. New locality, growing on the wall of the School House garden, opposite to Mr. Green's house, about 8 or 9 feet from the ground. H.W.T.

Ribes grassularia. Apparently wild, growing on the carriage road to Brownsover. A.P.B.

Cardamine amara. On the river bank below the Avon Inn, and near Holbrook Grange. L.C.

Orchis morio. Numerous varieties in colour, varying from the ordinary dark purple, through pink to pale pink were observed between Brownsover and Clifton, by the canal; puce varieties between Brownsover and Churchover; and pure white by Rainsbrook. A.P.B.

Scleranthus annuus. Barrow Hill, Daventry: new locality. H.W.T.

Specularia hybrida. Same locality as last: new locality. H.W.T.

Campanula patula. Abundant on both sides of the road at the Brinklow end of Coombe Wood, about 200 yards before reaching the Lodge. H.W.T.

Luzula congesta. New plant: Coombe Wood, Brinklow end. H.W.T.

Carex pallescens }
,, *pendula* } Coombe Wood. H.W.T.

,, *ovalis.* Field beyond Barby, near a disused mill. H.W.T.

,, *muricata.* New locality: roadside, near Barby. H.W.T.

Veronica scutellata. Field beyond Barby, near the disused mill in great abundance. H.W.T.

Festuca sylvatica. Beside the old canal beyond Newbold; also in a cornfield beside the footpath to Newbold, on the left after crossing the Leamington Line. H.W.T.

Festuca sciurioides. Fields towards Newbold and Lawford. H.W.T.

Polygala depressa. Coombe Wood, Brandon end, but less plentiful than formerly. H.W.T.

Ranunculus Drouettii. Pond in a field beyond Churchover. L.C.

Scolopendium vulgare. In a wall near the Church of Holy Trinity (probably a seedling from a garden). L.C.

Saxifraga tridactylites. Wall near Newbold, and at Marton. L.C.

Saxifraga granulata. Beyond Bilton, where the Leamington Line crosses the road. A.P.B.

Ditto. In a field on the right of the Brownsover Road, about 100 yards beyond the viaduct. L.C.

Habenaria chlorantha. One specimen by the canal near Clifton. A.P.B.

Ophys apifera. Rather plentiful on the canal bank near Clifton. L.C.

Orchis incarnata. One specimen on the canal bank near Newbold. (Finder unknown).

Neottia nidus avis. In Princethorpe Wood. L.C.

Ophioglossum vulgatum. Very fine specimens on the canal bank near Clifton. L.C.

The fine autumn gives us a rather long list (though we fear a sadly incomplete one) of the flowers which remained on November 1st, 1877, as follows. The numbers refer to the Rugby Catalogue of Plants.

28, 29, 30, 51, 52, 53, 64, 71, 83, 118, 134, 160, 188, 199, 207, 212, 213, 225, 242, 263, 278, 281, 284, 323, 324, 329, 364, 392, 506, 599, 603,

614, 639, 643, 660, 664, 684, 685, 687, 694, 712, 734, 763, 818, 902, 905, 982, 992, 1012, 1016, 1049, 1061, 1134, 1143, 1152, 1159, 1365, 1366, 1368, 1549, 1564.

We cannot close our report for the year without an allusion to the sad loss we have sustained, in the removal by death, of that veteran botanist and kind friend to our Society, the Rev. A. Bloxam of Harborough Magna. We owe to him many of the most valuable observations of our former reports, as well as many of our best plants. We may specially refer to authentic specimens of our local Roses and Rubi, on which difficult genera he was one of the few living authorities. His genial manner and uniform encouragement to all interested in Natural History endear his memory personally to many among us.

Description of the Plates.

Plate 1: Chart shewing readings of thermometers, barometer, and rain gauge at Rugby for 1877. In the upper part of the chart, the highest and lowest lines shew the readings of the maximum and minimum thermometers, the intermediate line corresponding to the readings of the dry bulb thermometer at 8.15 a.m.

The barometer readings are shewn after correction for temperature and sea level.

The vertical lines at the bottom of the chart shew the daily rainfall in inches and tenths.

Plate 2: Portion of corroded surface of limestone plateau, Ingleborough, drawn from nature and on stone by Rev. T. N. Hutchinson, to illustrate his paper on the origin of such surfaces, page 30.

Plate 3: Detached portions of such surfaces that have been removed from the Ingleborough plateaux. Not drawn to scale, but with the dimensions given in feet and inches. The lower figure is a plan of a curiously water-worn mass still remaining on the northern slopes of the mountain.

Plate 4: Sketch to illustrate anonymous paper on 'Beavers in Bute,' page 27. [The original sketch was drawn in too faint ink, and failed to print: the plate now printed was drawn to meet the emergency by a less skilful hand.]

Plate 5: Sketches to illustrate paper on 'Monkeys,' page 20, by N. F. Jenkins.

Plates 6, 6A, 6B: Drawings by L. Speed, to illustrate H. Weisse's paper on 'Continuous Edges,' page 18.

Plate 7: Sketch by L. Speed of a Monstrosity in Apple Flowers, exhibited by Mr. Cumming. From a drawing made at the time.

Plate 8: Sketch by H. F. Wilson of the New Zealand variety of the Bracken: see page 36.

Plate 9: Papyrograph drawing of a Beaver Family, engaged in the production of one of their well-known Beaver Hats. [Imaginary: by an Unknown Hand.] See page 27.

Plate 10: Ground plan of the Temple Observatory, papyrographed by Mr. Seabroke.

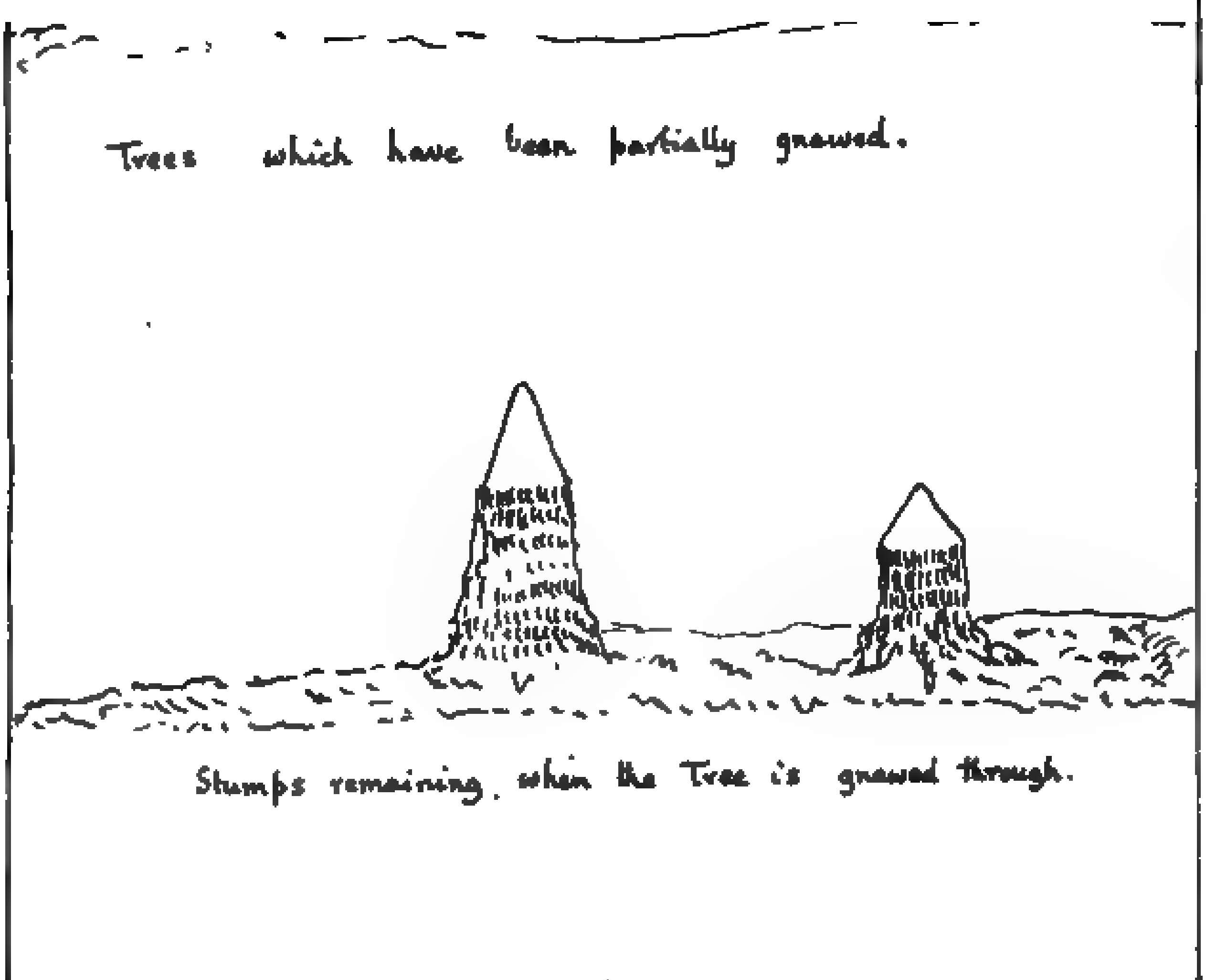
W. Billington, Printer, Rugby.

CORRODED LIMESTONE. YORKSHIRE. PLATE II

1

2

Plate 4



Sketch shewing how Beavers gnaw the stems of Trees: in Bute.

Plate 5

.1.
foot of Siamang monkey.

fig. 2. Sketch of skull of Monkey

fig. 3. Portrait of the Douroucouli.

Drawn by N.F.J.

Plate illustrating a Paper on Monkeys, p. 20, by N.F. Jenkins.

Plate 5

.1.
foot of Siamang monkey.

fig. 2. Sketch of skull of Monkey

fig. 3. Portrait of the Douroucouli.

Drawn by N.F.J.

Plate illustrating a Paper on Monkeys, p. 20, by N.F. Jenkins.

Plate 6

Drawn by L. Speed

2

Fig 4.

This and the two following plates are drawn to illustrate a paper by H. Weisse continuous Edges, p. 18

Plate 6 A

Drawn by L. Speed, to illustrate Paper VII B on "Continuous Edges," p 18.

Plate 6 B

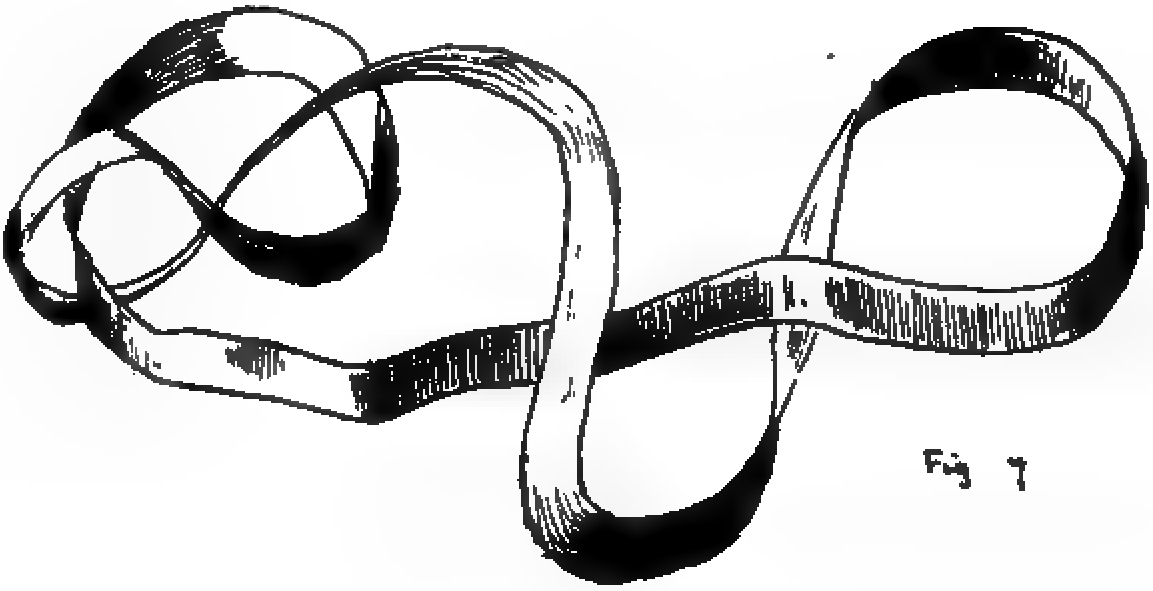


Fig 7

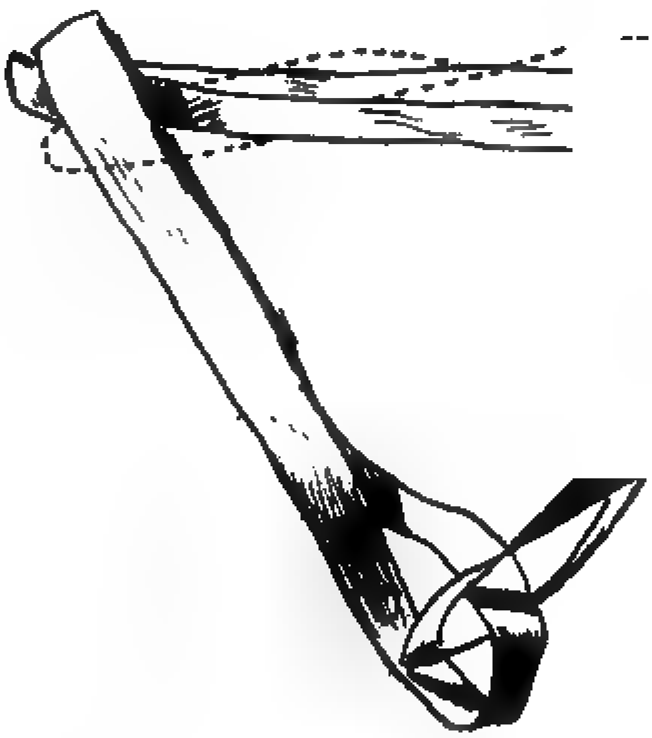


Fig 5.

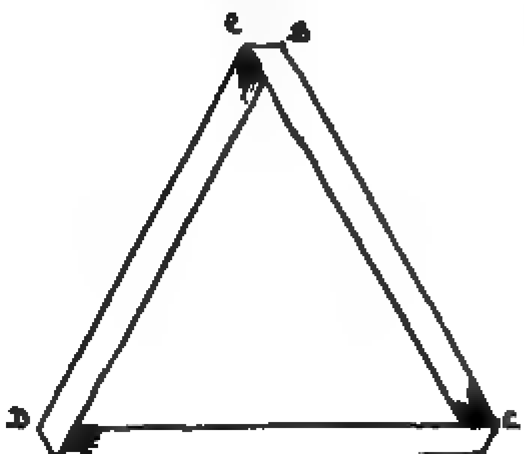
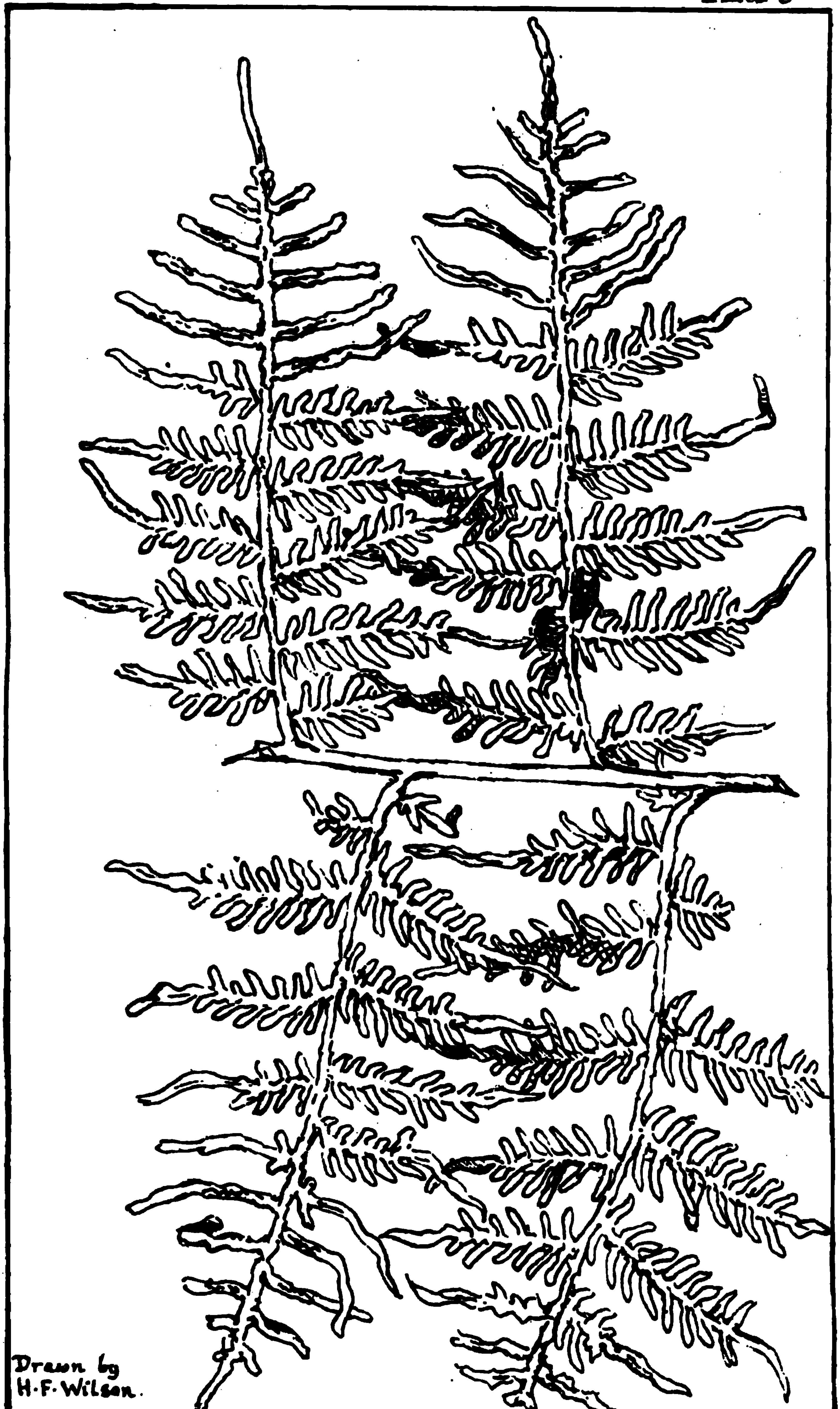


Fig 6

Drawn by I. Speed, to illustrate H. Weisse's paper on Continuous Edges, p.18.

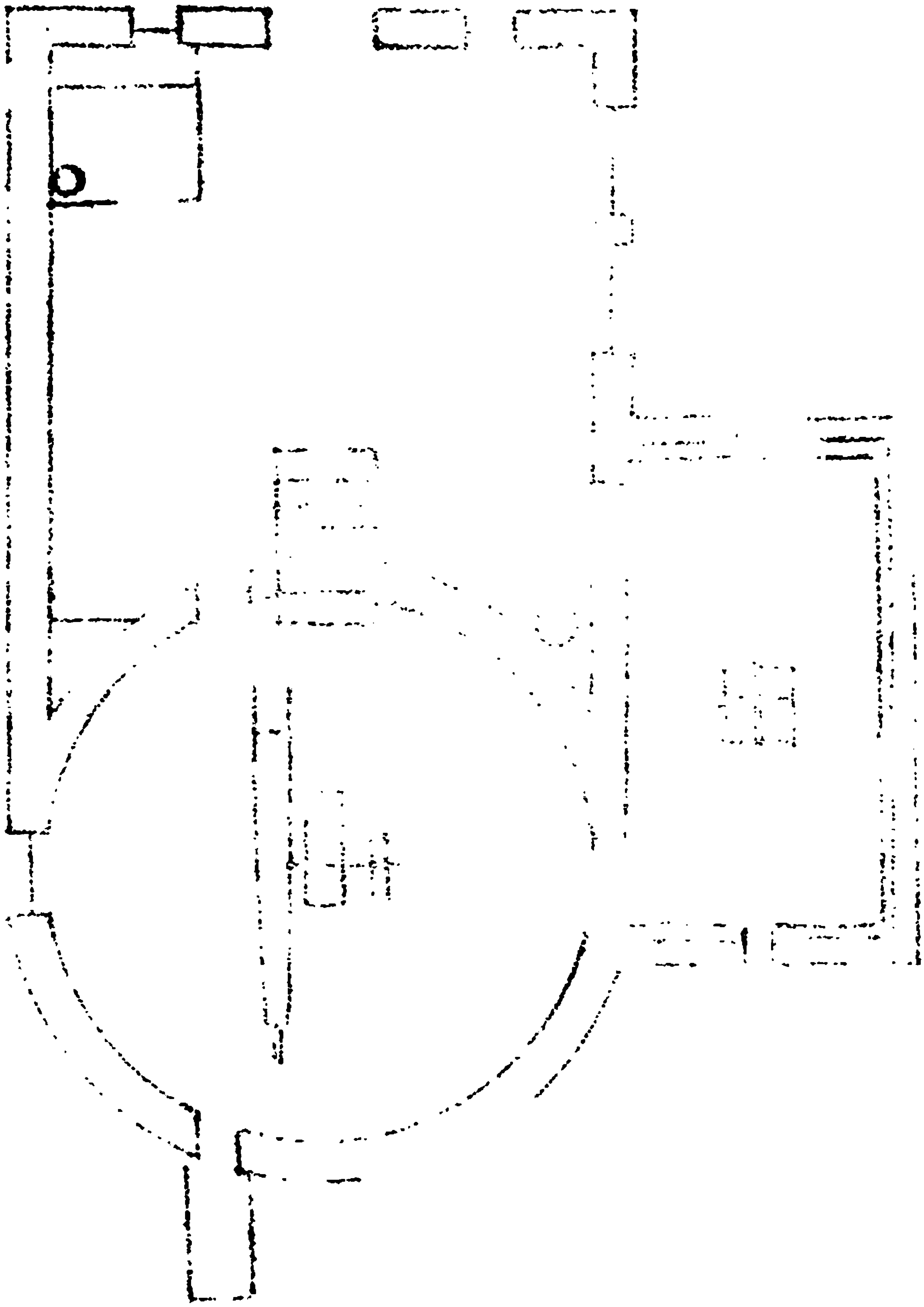
Plate 7

Drawn by I. Speed : sketch of a monstrosity in the flower of the Apple.



• Sketch of Pteris aquilina, var. esculenta, from New Zealand: see Page 36.

Plate



Report on the Temple Observatory,

FOR THE YEAR 1877.

DURING the first half of the year 1877 the work was carried on in the old Observatory in Mr. Wilson's garden. As in former years, it consisted mainly of taking double-star measures and spectroscopic work. The double stars were selected chiefly with reference to the "Preliminary List of Binary and other interesting Double Stars," by Messrs. Wilson and Gledhill, that appeared in the monthly notices of December, 1876. The whole of the measures taken during the last 3 years, up to the time of dismantling the old Observatory, have been presented to the Royal Astronomical Society, and are published in Vol. 43 of the Memoirs. They contain the measures of 398 double and multiple stars. No other work of the Observatory has been published during the year, but the Curator has continued his investigations into the motions of stars in the direction of the line of sight by the spectroscopic method.

The principal work of the year however has been the rebuilding of the Observatory. This therefore seems the proper occasion for describing it, and the instruments, in some detail; and to this Report reference will be made in future years.

A small piece of land was purchased in the year 1876, by the Governing Body, as a site for the Observatory and Curator's house. It has a frontage of 49 feet on the south to a quiet road, and runs back 128 feet, and is bounded on the east, west, and north by walled gardens. It is most conveniently situated, being as central among the boarding houses as any spot that could have been chosen. The arrangement of the ground will be seen from the accompanying plan. The house is an eight-roomed house, with walled back yard and separate back entrance, and is assigned by the Governing Body, free of rent, rates, and repairs, to the Curator, or Sub-Curator, as an acknowledgment of his services.

The Observatory is placed at the north end of the ground, with an asphalted area in front of it and on the east side. The door leads at once into a room 16 feet square, with tiled floor, called the Computing Room. This is lit by two windows on the west side, beneath which is the writing table, and on the sides of which are bookshelves and a fixed portfolio for diagrams. In the south-east corner is a small space boarded off and fitted up for photographic purposes, with supply of water, etc. In this room stands the mean-time clock, and side tables for galvanic batteries, coil, and other requisites. From the Computing Room steps lead up to the Equatorial Chamber, which is circular, 16 feet in diameter, with 14 inch walls 6 feet high, surrounded by a strong wooden wall-plate, in which are half-sunk 9 iron wheels, flanged on the outside, 10 inches diameter, on which the roof rotates. The floor of this chamber is 3 feet 8 inches above the floor of the Computing Room, and the space below is used as a lumber room, being entered by removing the steps before spoken of. A window on the east side, and another in the shutters, give light to the room.

The roof is a cone, with two shutters, each 1 foot 6 inches wide and about 20 feet long, opening from the base to the summit, hinged on a strong framework. They are opened by the hand, and supported in a vertical position. The roof consists of a framework of light rafters, fitted at the top into a square frame which supports the shutter frame; the lower ends of the rafters are bound with hoop iron, and rest upon an iron ring cast in 8 segments, and are also bolted to the ring. The ring is a horizontal annulus, 4 inches wide and ½ inch thick, with a plate of the same dimensions, making an angle with it along its outer circumference, coinciding with the slope of the roof, and strengthened by connecting flanges. At the inner edge of the annulus, on its lower side, is a row of cogs in which works a fixed toothed pinion, turned by a handle, and within easy reach from a low stool. The rafters project beyond the wall, and a horizontal plate of zinc attached externally to the walls below the eaves prevents draught. The rafters are covered with boards, over which is glued a stout canvass, well painted. The walls of the room, where not otherwise occupied, are hung with the Harvard College Astronomical pictures, and a few by De la Rue.

The central pillar supporting the Equatorial is of stone, 4 feet 9 inches high to the iron cradle, and 2 feet 4 inches by 10 inches

in section. It rests on brickwork at first 3 feet 3 inches by 4 feet 9 inches, then 5 feet 3 inches by 6 feet 9 inches, which is built on concrete 10 feet square. Of course the joists of the floor do not touch the pillar.

The Transit Room is on the same level as the Computing Room, and opens out of it at its north-west corner, and thus is placed at the west side of the Equatorial Chamber. An opening in the wall of the Equatorial Chamber into the Transit Room permits any one standing at the hour circle of the Equatorial to read the Sidereal Clock in the Transit Room. The Transit Room is 14 feet by 7 feet, and is covered like the Computing Room by a low pitched roof of zinc plates over felt; a clear space, with very free current for air, being left between it and the lath and plaster ceiling, for the sake of coolness. The shutters give a clear opening of 11 inches. The Instrument rests on a stone pier, 3 feet 2 inches high and 2 feet square at its base, perforated to give room for the knees of the observer. It has a foundation similar to that of the Equatorial, but smaller. The floor of this room is also of tiles.

In this room stands a Sidereal clock, and there is also a pendulum swinging, driven by a battery and the Meantime clock, as a working model to shew how time is transferred from a Standard clock.

The Transit commands an excellent southern horizon, so that Fomalhaut and even α Columbae may be seen; but the northern horizon is obstructed. Stars of 35° N. P. D. can however be observed at their inferior transit.

Opening out of the Equatorial Chamber on its north side is the Heliostat Chamber, which is at present a wooden temporary erection approached from the outside, with merely a small opening into the Equatorial Room. The light of sun or stars will fall on the reflector through the open shutters of the roof, and be then reflected in a line due south across the Equatorial Room, and through an opening in the wall into the Computing Room, where a telescope will be fixed to receive them. This combination will probably prove of some service in celestial photography.

Detached from the Observatory, and standing near its south-east corner, on the asphalte area before spoken of, is the Reflector Hut, which is of wood, and mounted on wheels, which run on rails fastened to sleepers bedded in the asphalte.

Lastly, in front of the Observatory door, on the same area, is a

strong brick pillar, with a slate top, which will serve as a stand for a portable telescope, and for sundry other purposes.

The rest of the ground is laid out in grass and flower beds as a garden belonging to the Sub-Curator.

The total cost of the Observatory and House was as follows:

	£.	s.	d.
Observatory	468	1	0
House	684	9	6
Architect, Clerk of Works, and Sundries ...	82	0	6
	£1234	11	0

and this was defrayed by Subscriptions from the Masters, Old Rugbeians, parents of boys now in the School, and other friends.

We now proceed to the description of the Instruments. The Object Glass of the Equatorial is 8¼ inches in diameter, and was made by Alvan Clark, and purchased from him by the Rev. W. R. Dawes in the year 1859; the mounting of the Instrument was also constructed by the same maker, at the instance of Mr. Dawes, for the purpose of carrying the Object Glass in question. In the year 1864, Mr. Dawes, requiring a larger Instrument, sold this one to the Rev. H. E. Lowe, from whom, in 1871, Mr. Wilson purchased it for 400 guineas. The copies of the letters from Mr. Dawes and Alvan Clark, with reference to the Instrument, recount its further history, and are therefore worth preserving. Copies are appended to this Report.

The Object Glass has a focal length of 108¾ inches, and with its cell is carried by a tube of wood which gives sufficient rigidity combined with lightness; at the eye end a brass sliding tube carries the eyepiece and other accessories. The finder has an aperture of 2 inches. The mounting is of the German form, and the bearing surfaces are of such careful construction that a very small force is sufficient to move the Instrument; the polar axis forms the diameter of a semicircular iron cradle which is adjustable by set screws; and in the space between the polar axis and cradle is the driving clock, the regulator of which is a Bond's spring governor, keeping very accurate time. The Declination circle reads by Vernier to 20″, and the hour circle to 2ˢ.

After dismounting the Instrument in the old Observatory, every part was thoroughly examined and cleaned, the brasswork re-lacquered, and the tube and ironwork painted. Gas has been laid

on to the lamp for illuminating the field, and also to two small lamps for reading the circles. The ordinary eyepieces range in power from 90 to 1000. The Micrometer is by Dollond; it is of the parallel wire kind, and of the best construction, and carries a position circle, reading to 10ths of degrees. From a number of careful determinations of the value of turns of the Micrometer screw, it is assumed that, on the Equatorial, $5.\dot{3}$ divisions on the screw head correspond to 1″: the true value is probably somewhere between 5.33 and 5.34.

The Transit Instrument is the gift of Mr. Edward Crossley, F.R.A.S., of Halifax, and is $2\frac{1}{2}$ inches in diameter, and 29 inches focal length; it is carried on a cast-iron frame in the manner usual in portable transits, and has the ordinary adjustments, and a setting circle reading to 1′. The eyepiece carries a system of 7 vertical and 2 horizontal wires, all of which are fixed.

The Sidereal Clock is by Cooke and Sons; it has a gravity escapement, and the pendulum is compensated by mercury in the usual manner; there is a second train of wheels taking motion from the sidereal train, which move hands showing mean time on a small dial on the face of the clock. There are contact springs for sending an electric current at each second, for the purpose of controlling other clocks. The Mean Time Clock has a Graham's dead beat escapement, and a pendulum of well-seasoned deal soaked in hot paraffin with a heavy leaden bob. There is an arrangement for sending electric currents, for the purpose of controlling other clocks. The pendulum is carried by a longer spring than usual, passing through a slit in a metal plate, and this plate is moveable by a screw, so that the virtual length of the pendulum can be altered at pleasure. By this means the clock, whenever in error, can be brought back slowly to the correct time, without the risk of any clock controlled by it breaking away from such control.

The Reflector stands by itself about 4 yards from the south-east corner of the Observatory building, and is covered by a wooden hut 7 feet 6 inches high, already mentioned, running on wheels; there are folding doors in front, and on opening these the hut can be run on its rails towards the north clear of the telescope. The mirror of the telescope is by With, and is $12\frac{1}{2}$ inches in diameter, and 6 feet 6 inches focal length; it is carried at the bottom of a sheet iron tube, which again is carried on a very strong equatorial mounting, and

driven by a clock. This Instrument is chiefly used with the larger Spectroscope, and for that purpose a light framework of iron is added, to carry a pivot at the end of the Spectroscope opposite to the eyepiece of the telescope, thereby relieving the eyepiece of the strain due to the whole weight of the Instrument. There are no position circles to the reflector, but their absence is somewhat compensated by the addition of a 3 inch telescope, with a large field, as a finder. The whole of this Instrument, with the exception of the glass, was made in Rugby.

The Spectroscope is constructed with a collimating lens of $\frac{3}{4}$ inch aperture, and 5 inch focal length; and the observing telescope is of similar aperture. The prisms are 1 inch across the face, and are 5 in number, each of an angle of 60°: they are arranged on the outside of a bent steel spring, which on being coiled more or less brings different portions of the spectrum into view. The light passes first through the lower portion of each prism to the last, when it is returned by reflection through the upper portion of each to the object glass of the observing telescope; then it is reflected by a right angle prism to the eyepiece.

In addition to the two larger telescopes is a small 3 inch refractor, carried by alt-azimuth mounting on a tripod stand of the usual form; this was the gift of Mr. Ormerod, O.R.

A Siderostat was constructed by the Curator about a year ago rather as an experiment than otherwise. The framework is of wood, and the clock and moving portions of metal; the mirror is 12 inches in diameter. It is proposed to use it in connection with one of the mirrors presented by Mr. A. M. Worthington. These mirrors are of speculum metal 12 inches in diameter, and were ground and polished by Mr. Brewin, late of Leicester. They are 12 feet focal length, and therefore too long to be mounted equatorially with ease, but will probably answer admirably in connection with the Siderostat for photography. In connection with the Spectroscope is a Ruhmkorff's coil and batteries, for producing spectra for comparison.

The Rules appended hereto have been issued by the Headmaster for regulation of the Observatory.

The hours during which the Observatory has been open for Members of the School were, for the month of December last, on fine evenings, from 6.30 to 7.30 on Mondays, Wednesdays, and Fridays, and from 5.30 to 6.30 (and for Upper School only from

8 to 9) on Tuesdays, Thursdays, and Saturdays, while those two or three who really work at the subject have been allowed to stay a much longer time. The Observatory was opened to Members of the School in November, 1877, and since that date 241 names have been recorded in the Note Book.

During the hours just mentioned, the Sub-Curator, Mr. Percy Smith, has always been present, and has assisted members of the School in taking Observations with the Equatorial and Transit, and during most of the time the Curator has also been present.

The following presents have been given to the Observatory during the year.

A small Gregorian Telescope, date 1720. ...	Mr. R. H. Scott.
A Summary or Index of 3062 double stars, from Struve, forming Vol. 1 of the Dun Echt Publications	Lord Lindsay.
Tacchini on Transit of Venus	Dr. Oldham.
List of Double Stars	Ormond Stone.
Wooden Model, showing the principle of an Equatorial Mounting	Mr. Donkin.

GEO. M. SEABROKE, Curator.

DESCRIPTION OF AN EQUATORIAL, RECENTLY ERECTED AT HOPEFIELD OBSERVATORY, HADDENHAM, BUCKS (ENGLAND), BY THE REV. W. R. DAWES.

(From the Monthly Notices of the Royal Astronomical Society.)

Haddenham, near Thame,
November, 1859.

My observatory was furnished in May last with an equatorially-mounted telescope by Messrs. Alvan Clark and Sons, of Boston, U.S., which in several important points differs from any other in this country; and I therefore hope a brief description of it may not prove uninteresting to the Royal Astronomical Society.

The form combines great firmness and compactness with considerable elegance of design. The massive part of its structure is of cast-iron, the base of which is firmly bolted down to a stone pier. The semicircular form of the upper part affords a secure position for most of the wheel-work of the driving-clock of which the going-weight descends in a groove on the east side of the pier, and is not seen in the drawing. The space between the polar-axis and the semi-circular bed-piece is occupied at its lower part by the hour circle. Immediately above this is a sector, which clamps on to the axis, and the wheel-work of the clock occupies the upper portion. The sector has a radius of rather more than 9 inches, and an arc of 30°, or two hours of right ascension. This arc has a face of an inch and a half in breadth, between which and a cylinder 7 inches in circumference there is just room enough for two thin bands of sheet-brass, each of about three-fourths of an inch in width, to pass side by side. These bands are both keyed by the end into one groove in the cylinder, at such a distance that they cannot overlap or interfere with each other. They are then bent round the cylinder in opposite directions, the end of one being fastened to one extremity of the arc of the sector, and the end of the other at the other extremity of the arc to a piece of brass which is acted upon by a screw and nut, for giving to both the bands a due degree of tension. The sector and cylinder thus move together without friction, irregularity, or lost time.

Upon the same arbor with the cylinder is the wheel, 15 inches in circumference, in the racked edge of which the driving-screw works. This arrangement gives the screw about the same driving-power as if it acted on the edge of a wheel nearly 40 inches in diameter, fixed on the polar axis.

I have every reason to be satisfied with the going of the driving-clock; and the cylindrical bob of the pendulum being screwed on to its steel rod, the rate is capable of adjustment to the greatest nicety. Great care has been bestowed

by the makers upon the accurate dividing of the wheel-work; and I have much pleasure in acknowledging that its performance fully bears out my expectations, founded on the character given by the Messrs. Bond of the clock-work applied by the same makers to the great Munich Equatorial in Harvard Observatory, which has been so successfully employed for the purposes of telescopic photography. While the speed of the clock is regulated by the vibrations of the half-seconds pendulum, the action of the pendulum on the wheel-work is rendered smooth and equable by an ingenious application of Bond's *Spring-governor*; and so perfectly successful is this contrivance, that with the thread of the Micrometer bisecting a star, and a power of 800 or 1000 on the telescope, no interruption or jerk from the escapement is perceivable.

For producing a slow motion in right ascension, the driving-screw is mounted on a brass frame, which, being carried by a fine screw under the observer's control, acts as a slipping-piece through nearly five minutes of time.

A firm clamp, close to the cradle of the telescope, fixes the declination-axis, and is accessible to the observer both at the eye-end, and also during the setting of the declination-circle. A slow-motion screw acts on an arm extending from the clamp to the bottom of the cradle to which the screw is attached.

To permit the adjustment of the polar-axis to the latitude and meridian of the place, the upper part of the cast-iron bed-piece is made with a groove, which receives loosely a projecting keel on the portion bolted down to the pier. The form both of the groove and of the keel being semicircular, the upper portion is moved upon the lower by the stout screw which is seen in the drawing, and the polar-axis is thus easily raised to the required angle. The adjustment to the meridian is performed by the screws on each side of the groove in the upper piece pressing against the keel in the lower, which has play enough in the groove to allow of a moderate degree of azimuthal motion.

To facilitate the finding of objects in Mr. Clark's "Two-eye-piece Micrometer," when their distance exceeds the field of one of the eye-lenses, the finder is furnished at its eye-end with a small position-circle divided into degrees. The thick wires of the finder being placed in the direction of the objects to be measured, the reading of the position-circle indicates the approximate setting for the micrometer, whereby the two objects may be immediately found by their respective eye-lenses. The aperture of the finder being two inches, it will show a star of 9¾ magnitude of Struve's scale.

The object-glass of the telescope has a clear aperture of 8¼ inches, and a focal length of about 110 inches. The materials were furnished by Chance and Co., of Birmingham. The figure is excellent to the circumference, and the dispersion but little over-corrected. Its performance fully supports the character of Mr. Alvan Clark's object-glasses, and I believe it to be capable of everything which can be performed by such an aperture. It clearly divides γ^2 Andromedæ, and shows the smallest companions among the stars of the Pulkova Catalogue.

Hopefield, Haddenham, Thame,
June 20, 1864.

Rev. Sir,

In reply to your note of enquiry received yesterday, I have the pleasure of stating that the telescope I have to dispose of has a clear aperture of 8¼ inches. It was made expressly for me by Mr. Alvan Clark, of Cambridge, Massachusetts, out of discs of glass selected from the stock of Chance and Co. of Birmingham. It has given me the utmost satisfaction, being one of the most perfect instruments I have ever seen. It is equatorially mounted in a most convenient way, the principal objection to the German mode of mounting being obviated by a simple contrivance, which permits all stars to be observed from their rising to their setting, without the very inconvenient necessity of turning over the telescope from one side of the polar axis to the other. The driving clock is regulated to the greatest nicety by a pendulum vibrating half seconds, and so truly is it capable of carrying the telescope, that I have often left a double star between the wires of the micrometer, and after nearly an hour's absence have found it precisely in the same situation. The perfection of the object glass has effected the discovery of several excessively delicate double stars which had escaped the close scrutiny of the Struve's with the Dorpat telescope of 9.6 inches aperture, and the Pulkova of 15 inches. Herr Otto Struve, when here in 1860, ascribed this remarkable circumstance entirely to the superior definition of the object glass. I have on many occasions seen with it the closest satellite of Saturn (Mimas), and also the only known satellite of the planet Neptune.

The astronomical eyepieces extend from 92 to 1000, as carefully determined with a good dynamometer. There is also a transparent diagonal for solar observations, forming part of an ingenious apparatus for sketching the solar spots, (or any other sufficiently bright celestial object), somewhat on the principle of a camera lucida.

The present equatorial mounting has been in use only three years, and its performance is now in fact even better and more uniform than when it was quite new.

Mr. Clark brought over a previous mounting on the same plan, and two object glasses in 1859, and one of these (of 8 inches aperture) with the mounting I disposed of for him for £500. He constructed another mounting for the 8¼ inch object glass, which I kept for my own use, introducing into it several considerable improvements which my two years' experience with the other enabled me to suggest; and in doing so he also complied with my request to throw all the expense into the perfection of the working parts, all others being painted of a neat stone colour;—the total expense being much diminished, and the deterioration of the instrument in a great measure prevented.

I am, Rev. Sir,
Your obedient Servant,
W. R. Dawes.

The Rev. H. E. Lowe.

Cambridgeport,
Feb. 5, 1871.

Dear Sir,

Yours of January 14 was duly received. Its contents brought up some very impressive retrospections, especially where you allude to the pains bestowed upon the 8¼ inch object glass. I first wrote to Mr. Dawes in 1851, giving him some account of my efforts at lens grinding and the results. His reply was cordial and sympathizing beyond what I could have reasonably expected; and from that time to within a few weeks of his death, I had written him more letters than I have ever written to any other fellow mortal, all of which were answered, some at great length, in the most affectionate terms; beside, in 1862, after the settlement for the last work I sent him, the amount I had received from him in money was greater than I had ever received from any other individual in all my transactions with mankind.

Such material aid at the time was of great importance to me, but his published opinion, relative to the ability and faithfulness with which I was executing my work, was, as time has proved, of the greater.

I visited him in May, 1852, carrying with me this 8¼ inch glass and another of 8 inches, fitted both to a tube large enough for the larger of the two, and an equatorial mounting.

On my way to Aylesbury from Liverpool I made a short stop at Rugby, but saw very little of the place. I stayed with Mr. Dawes until the latter part of July, and was made very happy while there, and during a visit with him to London and Greenwich. We had many very good evenings while I was at his house, and he often exchanged glasses; and when I was about to leave he had not decided which to adopt, but remarked that it was strange if I had brought two object glasses between which he could not choose, but since it was so he must keep them both.

He paid me for them 1600 dollars. For 7¾ I usually get 800 dollars. He sold the 8 inch, with the mounting, and ordered from me another mounting afterward for the 8¼, with a request that all the parts where it was practicable should be painted.

He paid 1200 dollars for this mounting and eyepieces.

In his letters he always expressed much satisfaction with the working of this painted mounting, and in his last and kindest, lamented ever having parted with it.

I should charge at this time for such a telescope, 2500 dollars. I have sometimes trouble in getting observers to fully understand and manage well their driving clocks, but I still adhere to the same construction, with the exception of having the weight in pieces, so that more can be added when the weather is cold or oil thick. It should be driven with only just weight enough to make it go.

It will give me much pleasure to learn that it is in working order at Rugby.

I have two sons with me in business, 38 and 44 years of age, and both have visited England within the last six months—indeed the younger was with Professor Winloch's party in Spain, for observing the total eclipse, and is now on his way from Liverpool to Boston. Permit me to congratulate you on your ability to make a donation like the one in question.

Very respectfully yours,

James M. Wilson. Alvan Clark.

RULES FOR THE TEMPLE OBSERVATORY.

1. The *Curator* is appointed by and will hold office at the pleasure of, the Headmaster.

2. The Curator will be entrusted with the entire charge and control of the Observatory and Instruments and Books.

3. He shall undertake, if requested by the Headmaster, to give special instruction to selected members of the School in practical Optics and Astronomy, and give due notice of the hours and subjects of Instruction for the Term.

4. He shall from time to time, with the approval of the Headmaster, fix the hours at which the Observatory shall be open to members of the School for general observation and for use of instruments.

5. He shall keep an account of all original work done in the Observatory, and of all work done by members of the School.

6. He shall make an annual Report to the Headmaster, on the state of the Observatory and Instruments; the work done in it; the number of Visitors, and such other matters as may call for remark. The Report to be such as may be printed.

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1. The *Sub-Curator* is appointed by, and will hold office at the pleasure of, the Headmaster.

2. He will be required to reside in the Observatory Cottage, if not occupied by the Curator; and will have it free of Rent, Taxes, and Repairs, in return for performing the following duties.

3. He is responsible for the cleanliness and tidiness of the Observatory and premises: and for lighting fires in the Observatory when requisite.

4. He is responsible for attendance during the hours assigned for Visitors; and he is expected to interest and instruct members of the School to the best of his ability in all sorts of Astronomical Observations.

5. He is responsible for keeping a diary of observations made, and of Visitors to the Observatory.

6. He is expected to give a cordial assistance to the Curator in all original work.

T. W. JEX-BLAKE.

Oct. 17, 1877.

REPORT

OF

THE RUGBY SCHOOL

NATURAL HISTORY SOCIETY

FOR THE YEAR

1878.

"IIS QUIBUS NON CONJICERE ET HARIOLARI SED INVENIRE ET SCIRE PROPOSITUM EST, OMNIA A REBUS IPSIS PETENDA SUNT."

—BACON.

RUGBY: A. J. LAWRENCE (LATE W. BILLINGTON)

1879.

PREFACE.

Our efforts have so far this year been successful that we appear a month earlier than last year: but the credit for this is due to the printers, who have been most prompt and obliging.

The Society is fairly flourishing. The Entomological, Geological, and Archaeological Sections have been vigorous, though the workers in each are fewer than we ought to have. The Zoological Section has been in abeyance, though we hope only for a time. The Botanical Section has been chiefly conducted by outsiders, a reproach which will, we trust, be removed.

We append the Observatory Report, as usual.

The chief loss we have sustained in the past year is that of J. Lea, who was a very steady worker in the Entomological Section, and did much both for our local list and for the collection.

Our thanks are due to Mr. Bloxam for his constant interest and help: to Mr. Hutchinson for his numerous exhibitions and beautiful illustrations: to Mr. Cumming for much aid in the Botanical Section: to the Uppingham Society who welcomed and entertained us in our annual excursion, and Mr. Gillson who again assisted largely in carrying out the programme on that day.

A. Sidgwick, } *Editors.*
G. Jones, }

Rugby,
April, 1879.

ACCOUNTS.

May, 1878—*May*, 1879.

Cr.	£.	s.	d.		£.	s.	d.	Dr.
Balance, (see last Report)	12	5	0	Report for 1877	24	3	6	
Subscriptions	34	12	6	Plates for same	4	13	0	
Sale of Reports	1	2	0	Repairs, &c. to Room	2	19	0	
				Keys, &c.	3	2	10	
				Books and Periodicals	5	9	0	
				Balance	7	12	2	
	£47	19	6		£47	19	6	

ADDRESSES.

Lithographing: Mr. F. Grew, Moor Street, Birmingham.
Anastatic Printing: Mr. Cowell, Buttermarket, Ipswich.
Heliotype Printing: Messrs. Wright and Co., Kilburn Terrace, London, N.W.
Entomological Apparatus: Mr. Gardner, 52, High Holborn, London.
Mr. E. G. Meek, 56, Brompton Road, London.
Mr. Watkins, Shepherd's Bush, London.

RULES.

I.

THAT this Society be called "THE RUGBY SCHOOL NATURAL HISTORY SOCIETY."

II.

That the Society consist of Honorary Members, Corresponding Members, Members, and Associates.

III.

That Masters, and others connected with the School, or any Benefactor of the Society, be eligible as Honorary, and Old Rugbeians as Corresponding Members; that Present Rugbeians be eligible as Members, or Associates.

Of Officers:

IV.

That the Society's Officers consist of a President, Secretary, and Curator, and of the Keepers of the several Albums, and that these do form the Committee of Management, three to be a quorum.

V.

That all Officers be elected annually.

VI.

That when any office is vacant, the Committee do recommend a Member or Associate, or (for the office of President) an Honorary Member, for election by the Members of the Society, and that the election be by scrutiny.

VII.

That the President take the chair at all Meetings, but have no vote except in cases of equality.

VIII.

That the Secretary keep the Minutes of the Society's proceedings; keep a list of the existing Society, with the names and addresses, as far as possible, of all Corresponding Members, and a list of all Benefactors of the Society.

IX.

That the President and Curator form a Sub-Committee, for managing the finances and keeping the property of the Society.

X.

That the duty of the several Album Keepers be to call together Sectional Meetings; to receive all notices connected with their several Sections; to enter all occurrences of interest in their Album; and at the end of each year to furnish a Report of what has been done in their Section during the year.

XI.

That in the absence of any Officer, the Committee appoint a Deputy.

Of Honorary and Corresponding Members:

XII.

That Honorary Members be elected by open vote of the Society; pay an entrance fee of 10s., but no subscription unless specially called upon; and have all the privileges of Members, except that of voting and of receiving Report gratis: but that Benefactors of the Society who are elected Honorary Members be excused the entrance fee.

XIII.

That Corresponding Members be elected by open vote of the Society, without entrance fee, and have all the privileges of Members, except that of voting; but do not receive the Society's Reports without payment, for a supply of which they may pay a composition.

Of Members and Associates:

XIV.

That Members and Associates be proposed by a Member or Honorary Member, and the Members elected by ballot, one black ball to three white excluding.

XV.

That the number of Members be limited to fifteen.

XVI.

That no one become a Member or Associate without either paying a composition of 10s., or bringing a note to the President signed by his Tutor to allow a charge of 2s. 6d. per Term to be made in his bill.

XVII.

That Members may speak at all Meetings of the Society; may read Papers with the leave of the President; may introduce one Visitor at all Public* Meetings, and receive a copy of the Society's Report.

XVIII.

That Associates have the same privileges as Members, except the right of voting at Private Business Meetings.

XIX.

That any Member who in the course of the year shall not have read a Paper before the Society, shall require re-election by the Committee.

XX.

That any Member or Associate may be suspended or expelled from the Society by a vote of two-thirds of the Members present, if he, from any misdemeanour, or want of energy, appear to deserve such suspension or expulsion: but such a motion cannot be proposed again during the same Term after it has once been voted upon in a Meeting at which four-fifths of the Members then in residence have been present.

Of Meetings:

XXI.

That Ordinary Meetings be held once a fortnight, but that the Secretary be empowered to call Extraordinary Meetings when necessary.

XXII.

That Visitors may speak and read Papers at all Public Meetings, with the leave of the President.

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* It having appeared that Members and Associates have introduced other persons not belonging to the Society into the Society's room, it is necessary to state that this practice is not permitted by the Rules.

Of Reports:

XXIII.

That a Report be printed once a year, or oftener if the Committee think fit.

XXIV.

That an Editing Committee be appointed by the President for each Report.

Of New Rules:

XXV.

That, without notice given at the preceding Meeting, no change can be voted in these Rules, or any vote of Suspension or Expulsion passed.

XXVI.

That no change be made in these Rules, unless proposed by a Member or Honorary Member, and carried by the votes of two-thirds of the Members present.

XXVII.

That in all cases where one vote be wanting to make up a majority of two-thirds of the Members present, the President be allowed to vote.

PRIZES.

The Society gives a Prize (at present £2. to the first, and £1. if a second is adjudged) for an Essay on any subject connected with Natural History. The Prize is decided by a Committee of 2 Honorary and 2 Ordinary Members elected at the first meeting of the October Term. The Essays should be sent in to the President (anonymously) the second Saturday in the October Term, with a sealed envelope, containing the author's name. Preference is given to original work of any kind as compared with matter compiled from books or papers.

Former Winners of the Prize.

1871.	1.	H. Ricardo, on *Eyes and No Eyes.*
	2.	F. R. Hodgson, on *Pets.*
1872.	1.	L. Maxwell, on *Spectrum Analysis.*
	2.	H. N. Hutchinson, on *Motive Power.*
1873.	1.	Not awarded.
	2.	L. Knowles, on *Coal.*
	2.	V. H. Veley, on *Cross Fertilization.*
1874.	1.	V. H. Veley, on *Symmetry in Flowers.*
1875.	1.	H. F. Newall, on *Impressions.*
1876.	1.	Not awarded.
	2.	F. G. Hitchcock, on *Dogs.*
		Extra Prize. H. L. Stephen, on *Ghosts.*
1877.	1.	Not awarded.
	2.	G. Jones, on *Garianonum.*
1878.	1.	T. B. Oldham, on *The Geology of Rugby.*
	2.	L. R. Carleton, on *Freshwater Aquariums.*

LIST OF THE SOCIETY, APRIL, 1879.

Officers:

President: Mr. W. G. Michell
Secretary: G. Jones
Curator: T. B. Oldham
Curator of the Aquarium: L. R. Carleton
" " Eggs: A. S. Maskelyne
Librarian: C. E. Sayle
Album Keepers: Botanical, R. C. Cordiner
" " Geological, T. B. Oldham
" " Archaeological, G. Jones
" " Entomological, E. Solly
" " Zoological, (vacant)

Honorary Members:

Rev. Dr. Jex-Blake
Rev. T. N. Hutchinson, F.C.S.
Rev. C. Elsee
Rev. C. E. Moberly
C. Dukes, Esq., M.D.
A. Percy Smith, Esq., F.C.S., F.I.C.
H. T. Gillson, Esq.
J. L. Tupper, Esq.
G. Nutt, Esq.
A. E. Donkin, Esq.
Dr. Sharp
Colonel Carleton
Dr. Mackenzie
L. Cumming, Esq.
J. Collins, Esq.
M. H. Bloxam, Esq.
Rev. C. B. Hutchinson
Rev. P. Bowden Smith
G. C. Macaulay, Esq.
C. Ransome, Esq.
C. G. Steel, Esq.

Corresponding Members:

Lord Bishop of Exeter
W. C. Marshall
W. C. Eyton
T. G. B. Lloyd, F.G.S.
C. L. Rothera, B. Sc.
E. Cleminshaw
G. B. Longstaff, F.C.S.
F. C. Selous
H. N. Larden
N. Masterman
S. Haslam
G. M. Seabroke
Rev. J. Robertson
R. H. Scott, F.R.S.
W. B. Lowe
F. E. Kitchener, F.L.S.
H. N. Hutchinson
R. H. B. Bolton
H. W. Trott
M. J. Michael
H. G. Wauton
A. Sidgwick
Rev. J. M. Wilson

Members:

T. B. Oldham
R. C. Cordiner
G. Jones
A. S. Maskelyne
M. E. Sadler
L. R. Carleton
H. J. Elsee
C. E. Sayle
E. Solly
(all by Composition).

Associates:

(*a*) *by Composition.*

S.H.] C. H. Brocklebank
J. E. Marsh
F. A. E. Samuelson
G. B. Samuelson
C. E. Samuelson
S. H. Walrond
P.B.S.] F. H. Bowden Smith
E. F. Hodge
T. A. Wise
C.B.H.] H. E. Hill
C. H. Saunders
R.W.] L. A. Adamson
H. C. Baker
H. E. Bristow
W. L. Behrens
J. S. Campbell
H. C. Clifford
J. G. Cobb
T. H. Cobb
R. Evans
M. Firth
A. Firth
P. A. Haines
F. I. Maxse
A. W. L. Power
E. St. G. Pratt
A. W. Rumney
R. Titley
B. D. Z. Wright
E.A.S.] F. T. Arnold
G. F. S. Napier
C.E.] F. D. S. Bentley-Innes
N. F. Jenkins
R. L. Richardson
H.L.W.] J. A. Chamberlain
W. H. L. Copeland
B. B. Cubitt
H. J. Downing
F. H. Edwards
F. J. Hirst
W. Jones
H. Lupton
G. E. Ripley
R. I. Simey
R. W. Wilson
C. Wilson
J. K. Worthington
W.C.G.] R. H. Pope
W. H. Stone
TOWN] F. Gillson
C. E. Hall
C. H. W. King
H. Y. Oldham

(*b*) *by Notes.*

S.H.] F. Barkworth
M. B. Barnsley
B. W. S. Bolland
W. J. Cartwright
F. M. Feuerheerd
A. J. Hart
E. J. Hart
C. M. P. Hassall
W. D. Holt
J. S. Hoyle
Hon. R. Lister
C. Smith
W. J. Thorpe
H. J. C. Torry
H. E. Wootten
P.B.S.] C. E. Cobb
E. Heynemann
J. H. Newton
W. Tinker
C.B.H.] E. D. Boggs
J. Cartmell
A. L. Clark
H. L. Fowler
S. F. Gedge
W. M. Pike
R.W.] C. P. Allen
J. H. L. Baldwin
O. P. Behrens
H. C. Bond
C. A. S. Buckley
J. H. Cobb
G. Combe
A. F. Kitson
R. Unwin
E.A.S.] G. H. Aitken
J. B. Allan
W. R. Allan
H. M. Baker
R. N. Bealey
A. L. Bill
F. L. Bradley
C. D. Bradwell
A. Castle
A. Chance
L. H. Demuth
H. R. Drummond
T. Fernley
H. S. Fraser
J. B. Grahame
A. M. Grahame
G. Henderson
A. V. Holland
R. G. Hughes
H. V. Kilvert
W. B. Lawless
J. A. McMullen
J. F. B. Moody
F. S. Myrtle
W. Ranken
W. Scull
R. S. Smith
P. E. Tooth
W. H. Wayne
J. Whitaker
C.E.] H. T. Arnall
H. R. Brown
J. A. Chanler
H. Coote
H. G. Daymond
J. H. Dugdale
H. B. Firth
E. W. Greg
F. J. Hadden
B. R. James
A. T. Keen
C. C. Mott
F. C. Muriel
E. B. Ormond
F. B. Smith
E. W. Tobin
G. F. Underhill
W. Whitelegge
H. C. Wrigley
W.C.G.] E. H. Acton
E. A. Bird
W. S. Halsey
A. E. Hart
S. M. Kingdon
A. Macrae
F. H. M. Wayne

LIST OF PERSONS AND SOCIETIES AND JOURNALS TO WHICH COPIES OF REPORT ARE SENT.

Those marked * exchange Reports with us.

The Headmaster
The Chairman of Governing Body
The Bishop of Exeter
Lord Dormer, Grove Park, Warwick
Professor H. J. S. Smith, Oxford
Professor Newton, Cambridge
Rev. J. W. Hayward, Flintham, Notts
Rev. A. H. Wratislaw, Bury
Rev. J. Robertson, Harrow
F. E. Kitchener, Esq., Newcastle, Staffordshire
R. H. Scott, Esq., Meteorological Office
G. J. Symons, Esq., 62, Camden Square
W. Whitaker, Esq., F.G.S., 28, Jermyn Street, London, S.W.
S. Haslam, Esq., Uppingham
Nature, Bedford Street, Covent Garden
Geological Magazine
Jermyn Street Museum
Astronomical Society, Burlington House, W.
Linnean Society
Geological Society, Burlington House, W.
Radcliffe Observer, Oxford
*King Edward's School, Birmingham
*Clifton College N.H.S.
*Marlborough ,, ,,
*Wellington ,, ,,
*Cheltenham ,, ,,
*Winchester ,, ,,
Watford ,,
*Warwickshire ,, the Museum, Warwick
Northampton Nat. Soc., 26, Langham Place, Northampton
Leicester Philosophical Society
*Birmingham Society
*Bristol Naturalists' Society, Museum, Queen's Road, Bristol
College, Wellington, New Zealand
U.S. Geological and Geographical Survey of Territories, Washington
*Journal of N.H. Societies in Friends' Schools, (York)
*Naturalist's Field Club, Barrow-in-Furness

LIST OF PERIODICALS TAKEN BY THE SOCIETY,

AND KEPT IN THE SOCIETY'S ROOM.

Land and Water
The English Mechanic and World of Science
The Journal of Botany
The Entomologist
Nature
Midland Naturalist
Science Gossip is kindly placed in the Society's Room by Rev. T. N. Hutchinson

REPORT FOR 1878.

The following is a brief *resumé* of the proceedings of the Society during the year.

Meetings.	No. present.	Papers.
Feb. 9	55	The Telephone, by Mr. T. N. Hutchinson.
		*Pupae, by J. Lea.
		*A Haunted House, by M. E. Sadler.
		Humming Birds, by Anon.
Feb. 23	76	*Gothic Architecture, by G. Jones.
		*Campanology, by H. J. Elsee.
		Edible Fungi, by Mr. A. P. Smith.
		Burials of different Periods, by Mr. Bloxam.
March 16	69	Rugby Close, by Mr. Bloxam: [printed in the *Meteor*, No. 122, March 28, 1878.]
March 30	69	*Gothic Architecture (2), by G. Jones.
		*Bells, by H. J. Elsee.
		*Sallow Hunting, by J. Lea.
		Botany in Dorset, by H. G. Wanton (c).
		*Swallows, by R. C. Cordiner.
		*Bats, by J. H. Gair.
		A Grey Cat, by Anon.
May 18	—	*Compound Pendulums, by H. V. Weisse.
		Food and Muscles, by Mr. A. P. Smith.
		*An Effigy in Yorkshire, by M. E. Sadler.
		Note on the Microscope, by Mr. Wilson.

Meetings.	No. present.	Papers.
June 1	—	Rock-sections, by Mr. T. N. Hutchinson.
		*Cores and Bores, by T. B. Oldham.
		*Expedition to Brandon, by G. Jones.
		Insect Transformations, by Mr. Sidgwick.
June 15	—	*The Steam Navvy, by G. Jones.
		Insect Transformations (2), by Mr. Sidgwick.
		Peeping Tom, by Mr. Bloxam.
July 6	—	*Excursion to Lilbourne, by T. B. Oldham.
		* „ „ Seaton, by G. Jones.
		Microphone, by Mr. Seabroke.
		*The Dodo, by T. B. Oldham.
		Etymology in Wicken Fen, by M. J. Michael (c).
Oct. 19	—	Erratic Blocks on Ingleborough, by Mr. T. N. Hutchinson.
		*Shawell Brook, by G. Jones.
		Bee-orchis, by Mr. Cumming.
		Eucalyptus Globulus, by Mr. Bloxam.
Nov. 2	—	Sugar, by Mr. A. P. Smith.
		*Druidical Remains, by H. J. Elsee.
		*Remains in Suffolk, by C. E. Sayle.
		*Moth-attractions, by J. Lea.
Nov. 16	—	Flora of Napton, by H. W. Trott (c).
		Jablochkoff's Candle, by Mr. T. N. Hutchinson.
		Tree-shoots, by Mr. Cumming.
		*Aquariums, by L. Carleton.
Dec. 7	64	Gas and Electricity, by H. V. Weisse.
		*Geology of Rugby, by T. B. Oldham.
		*Cave's Inn, by G. Jones.
		The School Collection of Insects, by Mr. Sidgwick.

Those marked * are by present Members of the School.

[The most interesting papers (or portions of papers) selected from the above list are given below.]

PAPERS.

'*Pupae*,' by J. Lea.

'The subject of my paper to-night is that of a somewhat important and widely distributed section of Entomology, namely, Chrysalises, or Chrysalides, or Pupae, whichever you like to call them.

'One need not be particular about the exact time for this, but begin in autumn not earlier than September, and stop when you are tired of it, which will probably be before the moths come out.

'The correct article for the operation is a scoop, sold by all naturalists—except the Rugby one, Mr. Edmunds, on the Lawford Road;—this man informed me that he used to keep the required article and had sold all his, but as there was no demand for them he had not renewed his stock, and did not think it worth his while to do so. Some use a trowel, others a three-pronged fork, and the French, I believe, a broad chisel; but of course this does not matter. Next I shall give a few words about the localities where chrysalises are to be found. One is almost sure of success if one searches a park or any open space with a few scattered trees of a fair size, or a single tree in the middle of a field, having a certain amount of grass about their roots, and the soil soft. A spinney or a collection of trees is scarcely worth while searching, as the moth has such a variety of trees to select from whereon to lay its eggs, that one finds on an average a chrysalis under every sixth tree; whereas if there is a solitary tree, the moths of the neighbourhood would come there, and so good luck might be expected. Trees in a hedge are not at all productive. I have often looked under them and never found anything; for this I cannot state definitely any reason, so I will hazard no conjecture. Wherever there is a crevice among the out-spreading roots of a tree, or any cavity in the lower part of the trunk, filled with earth of a soft nature, there one should search. In these places turn over the soil to the depth of about two inches; or if there is a tuft of grass, pull it up and look under it; and in all cases put back the soil, to afford a burying-place for another year. Any tree in a good position is worth trying, but the trees at whose roots they are chiefly to be found are Oak, Elm, Ash, Willow, Poplar, and Birch; and of these Oak and Elm produce the greatest numbers. It is worthy of note that under Ash trees I have found that two out of three have been dead and mouldy, having very rarely found any dead ones under any other tree. I have not yet mentioned anything about Fir trees with the ordinary trees, as they require a different method. To

begin with, a fir tree by itself in a garden is of no use; but one wants a fir wood, and that not a Rugby spinney. Here you should dig about 2 feet away from the trees, and to the depth of the last season's leaf mould, and you must turn over a considerable amount of ground before you can hope to find anything. Some of the inhabitants of the fir woods spin amongst the needles, and you might come across them; but on the whole the operation is slow, though the chrysalises, if you find them, are well worth having. About the localities near Rugby I need say little, for fir woods I know of none available, and as for ordinary trees, they are fairly sprinkled about. Perhaps the best are about Newbold,—at least I have experienced greatest luck in numbers there. There is one difficulty, however, in digging about Rugby, which is this; as I said, the best place is a tree in the middle of a field, and not in a hedge on the side of the road, and consequently it is necessary to cross the country to find them. Now Rugby, as we all know, is not thickly interspersed with paths across fields, and being off a path is considered trespassing, so how are the trees to be got at? asking leave to cross every field everywhere would be a decidedly laborious task, and then perhaps leave would not be given; so we must either content ourselves with not procuring them, or else stick to the strict letter of the ancient proverb, "Where there is a will there is a way." For my part I have done the latter, and found it very successful, having possessed myself of between sixty and seventy chrysalises, and have been only caught off the path twice, and my discoverers were very civil and gave me leave to proceed.

'After obtaining chrysalises, the next thing is, how to keep them? I shall first give the correct way, quoted from the "Lepidopterist's Guide." "Subterranean chrysalises, when first secured, should, with as much of the cocoon as we can manage to save entire, be conveyed between layers of moss or anything to keep off pressure; on reaching home, they should be carefully deposited on, and covered over with some of the soil already mentioned, in some vessel of unglazed pottery ware, a thin layer of cocoanut refuse, or moss, previously cooked to destroy tenants, being placed over all, to preserve a certain amount of moisture." And in another place the same gentleman says, "Damping Pupae I have long been satisfied is a great mistake. It is well known that caterpillars, such as enter the earth to effect their metamorphosis, seek such corners and aspects as will protect them from the baking rays of the sun, or the drenching showers which come from the s.w.; they prefer the sides of trees and other objects which face the north, and we should therefore keep our chrysalises rather dry than otherwise." I am afraid I have not strictly followed this advice in everything; some of mine I keep in a biscuit tin, others in a wooden box, in whatever soil I could get, without analysing it to see if it corresponded to the *correct soil*, nor have I spread over the top either "cocoanut refuse," or "moss previously cooked to destroy tenants." Then, as to damping, I beg to differ in one or two points with the

editor of the Lepidopterist's Guide. I do not believe his theory of the N. side of a tree, since I have found quite as many on the S. or any other side where there was a suitable place. And as the chrysalises are more to be found in wet than dry places, I think that damping should be employed, more especially if they are kept in a warm room;—at any rate I keep mine damp, and the early spring moths are now daily coming out, imagining that they are warmed by the vernal sun instead of my study fire.'

Anonymous paper on '*Humming Birds.*' We extract the following.

'Mr. Wallace winds up with discussing the relations and affinities of Humming Birds. This affords, he says, a remarkably good instance of the principles of classification now adopted in Natural History. In the tropical parts of India and Asia there are found many small and brilliant-coloured birds, called Sun Birds. They have long beaks, extensile tongues, and live on honey and insects;—in fact at first sight they are just like humming birds, and the old naturalists took for granted that they were closely allied to them. It was in 1850 that Lucien Buonaparte, a great ornithologist, first placed the humming birds next to the swifts, and the sun birds in quite a different group. The fact is, that relationships between different families of birds are shown, not by those organs and arrangements that are specially adapted to their mode of life, but by those that are as it were out of sight. Porpoises, for instance, are modified externally so as to resemble fishes, and yet are true mammalia. Supposing one division of a family of birds for some reason to change their habits, they will very likely alter in colouring or the shape of their beak, but there will be nothing to alter the shape of their breast bone. The skeleton is, in fact, the most certain guide to the true classification of birds, because it appears to change its form with extreme slowness, and thus indicates deeper-seated affinities than those shown by organs which are in direct connection with the outside world, and are readily modified in accordance with varying conditions of existence. Another guide is the number, colour, and texture of the eggs, and a third the mode in which the feathers are arranged.

'Now by all these tests the humming birds and swifts are proved to be allied. The sternum or breast bone is not notched behind; the eggs are white, and generally only two in number; and the arrangement of the very compact plumage is nearly identical. The sun birds, on the other hand, have the sternum deeply notched, and have quite a different arrangement of plumage; resembling in both these matters the great family of the Passeres. Humming birds and swifts have both ten tail feathers—sun birds have twelve: the upper quill of the humming birds and swifts is nearly always

the longest—in the sun birds it is the shortest of all. It is very note-worthy that young humming birds have stumpy-shaped beaks, like swallows: most likely the tongue is not developed either at this age. The conclusion then, is, that similar circumstances have developed the same style of bird out of two quite separate families. Certain passeres and certain swifts, adopting as their way of life the search of flowers for honey and insects, have each invented, as it were, the same sort of tongue to do it with, and have adopted the same brilliant hues. But such organs and limbs as are of less importance remain as they were, and by these they may be readily assorted into their different families.'

'*Edible Fungi*,' by A. Percy Smith, (F.C.S.)

'Fungi belong to the division of Cryptograms or Acotyledons, which are characterized by the absence of flowers and seeds. They are propagated by means of spores, which differ from the cells of flowering plants in that they consist merely of a single two-coated cell, and do not contain an embryo.

'The mushroom or Agaric type may be regarded as the highest form of development among fungi.

'The parts of a mushroom are—

'The pileus or cap,
'The gills which bear the spores,
'The stem.

'To the majority of people who are not mycophagists, the common mushroom, Agaricus campestris, is the only familiar species, and every other kind is looked upon with suspicion, if not with fear. The fairy ring Champignon, one of the most delicious of our fungi, is generally neglected. The fragrant Chantarelle, the Morel, and the giant Puff ball, all delicacies of the highest order, are likewise kicked aside as unworthy of notice.

'It is my purpose this evening to enumerate and describe, more from a popular than a scientific point of view, some of the more common edible fungi which bear a reputation for succulence, and also a few of the poisonous sorts which have occasionally been eaten by mischance.*

'We will commence with the common mushroom, Agaricus campestris. [See Plate 3. fig. 1.]

'*Pileus.* Smooth or slightly scaled, of a white tawny or brown colour.

'*Gills.* Free. At first pallid, then flesh coloured, then pink, purple, ultimately black.

'*Stem.* White, solid, varying in shape, bearing a white persistent ring.

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* We regret that we have space only for the edible species.

'*Season.* Autumn.

'*Habitat.* Meadows.

'It is among the most widely distributed of fungi. It is abundant in America, and generally diffused throughout Europe, extending to Lapland, also found in Japan, New Zealand, and Australia.

'The French are very fond of mushrooms, but they neglect those that grow wild, and turn their attention to home cultivation. Large numbers are grown in caves in the neighbourhood of Paris, especially at Montrouge, Bayneux, St. Germain, and Moulin de la Roche; and not only do they supply the wants of Paris itself, but are exported in large quantities to England and other countries. During the siege of Paris mushrooms were of considerable importance as an article of food; and Berkley tells us of a Northamptonshire schoolmaster, who being unable to buy food for his children, kept them mainly on mushrooms for several months.

'Mushrooms may be grown almost anywhere. An enthusiastic mushroom grower of Brussels published, about 40 years ago, a little brochure on their cultivation in rooms, giving directions for the formation of beds in the corners of staircases, on sideboards, and elsewhere—thus combining the useful with the ornamental!

'In certain rare cases the mushroom has undoubtedly proved poisonous. Why, is not always easy to ascertain: in many instances, however; it has been due to decay of the mushroom, brought on by the attack of a parasitical fungus. An instance of this is mentioned in the *Gardener's Chronicle* for April, 1860.

'Also we can eat too much of a good thing. A surfeit of mushrooms may possibly prove as fatal to an ordinary individual as the lampreys and new ale did to King John. In any case young specimens should be preferred to old ones; their flavour is more delicate, and they are less liable to be preyed upon by grubs.

'A notice of the mushroom is scarcely complete without the mention of ketchup, the mode of preparation being probably known to all, viz., placing the plants in salt for some hours, when the juice exudes in abundance. It is next strained, boiled with spices, and bottled.

'Mrs. Hussey, however, recommends that the ketchup should not be boiled, but that the bottles of juice should be "topped up" with flavoured spirit.

'*The Edible Boletus*, B. edulis, fig. 2. Is one of the commonest and most delicious species, growing during summer and autumn in woods. It has a smooth yellow top, with tubes instead of gills, which are white when young, turning pale green. The stem is marked with a white reticulated network. When broken the flesh remains white. Mr. Worthington Smith says, "Whether boiled, stewed with salt pepper and butter, fried, or roasted with onions, this species proves itself one of the most delicious and tender objects of food ever submitted to the operation of cooking."

'*The Red-fleshed Mushroom*, A. rubescens, fig. 3. Is abundant

in woody places during the summer and autumn. It grows to a large size, and when broken the whole substance turns a *sienna red colour*. The top is brown and warty, gills white, stem bulbous.

'A near ally of the common mushroom is the *Horse Mushroom*, A. arvensis, fig. 4. It is the kind usually sold in Covent Garden as the true mushroom, from which it differs in its larger size, brown gills, and hollow stem. Moreover it turns yellow when bruised.

'*The Variable Mushroom*, R. heterophylla, fig. 5. Is also common in woods. It has a sweet nutty taste, white flesh, white gills. The top is variable in colour, but generally green; at first convex, and afterwards concave.

'*The Yellow-gilled Mushroom*, R. alutacea, fig. 6. Occurs in woods during the summer and autumn. The gills are thick, and of a yellow colour. The top is pale crimson, the whole plant is fleshy, and often grows to a large size.

'*The Chantarelle*, Cantharellus ubarius, fig. 7. Cannot be called common, but it is no rarity in certain districts. It grows on hedge banks, near trees. Epping Forest is a favourite locality. Its appearance is sufficient to distinguish it from all other species, and the smell is somewhat like that of apricots.

'*The Orange Milk Mushroom*, Lactarius deliciosus, fig. 8. Grows in fir plantations, but is not common. Its chief characteristic is, that when broken, the milk which exudes is orange red and changes to green by exposure to the air. One or two mushrooms of this class have yellow milk, and are poisonous, but they do not grow in fir plantations.

'*The Purple Cobweb Mushroom*, Cortinarius violacens, fig. 9. Grows occasionally in open places in woods. Its appearance is sufficiently characteristic to prevent any mistake.

'*The Maned Mushroom*, Coprinus comatus, fig. 10. Is only fit for food when young, as it decomposes when mature. It grows among short grass on lawns, and by roadsides. It is common in the London parks in October.

'*The Parasol Mushroom*, A. procerus, fig. 11. Is a well-known species. It grows in pastures, and is recognized by its spotted stem, with a movable ring, its scaly top, and the gills being absent at the insertion of the stalk.

'*The Plum Mushroom*, A. prunulus, fig. 12. Has pink gills running down the stem. It grows in woods and smells like meal. It is not very common.

'*The Oyster Mushroom*, A. ostreatus, fig. 13. Grows generally on old *elm* trunks. The gills and spores are white, and the top a dingy colour. This species is not recommended by some collectors, although it is by others.

'*The Lilac Stemmed Mushroom*, A. personatus, fig. 14. Is not common, but occurs occasionally in pastures. It grows in the autumn, and has a lilac band round the upper part of the stem.

'*The St. George's Mushroom*, A. gambosus, fig. 15. Appears in spring near St. George's Day, when few other kinds are found.

It is white, or yellowish white, all over. It grows on pastures and has a strong fragrant odour.

'*The Morel,* Morchella esculenta, fig. 16. The figure shows, better than any verbal description, what the morel is like. It is not common, but there is a wood in Bedfordshire, called "Morel Wood," where, according to Mr. Worthington Smith, this fungus *abounds.* The top is hollow, and forms a convenient receptacle in which to place minced veal, and so cook the morel between slices of bacon.

'*The Liver Fungus* or *Vegetable Beef Steak,* Fistulina hepatica, fig. 17. This fungus grows generally on oak trees. The taste resembles that of meal in a very marked manner: when cut, a red juice exudes. It is usually cut in slices and broiled with steak.

'*Spine-Bearing Mushroom,* Hydnum repandus, fig. 18. This genus is characterized by the awl-shaped spines on the under surface of the pileus. It occurs in woody places and shady roadsides in autumn. When raw the taste is slightly pungent, but when cooked it is a most agreeable article of food. Its colour is exactly like that of a cracknel biscuit.

'*The Viscid White Mushroom,* Hpgrophorus virgineus, fig. 19. Grows upon lawns and pastures. It looks and feels exactly as if made of wax. The gills run far down the stem. When getting old it changes colour, and is then unfit for culinary purposes.

'*Clouded Mushroom,* A. nebularis, fig. 20. Grows on dead leaves in moist places. The top is grey, the gills white. It possesses a powerful odour.

'*Giant Puff Ball,* Lycoperdon giganteum, fig. 21. This species is very common in some places. It is of all sizes. The skin is like a white kid glove, soft and smooth. Only young plants are edible. When old, the interior becomes changed from a firm spongy texture into a mass of brown dust, which is not only non-esculent but injurious. It is usually cut in slices, which are dipped in yolk of egg and fried in butter. It forms an excellent substitute for pastry, if served with jelly or jam.

'*Pear Milk Mushroom,* Lactarius volemum, fig. 22. The milk of this mushroom changes from white to umber colour when the plant is bruised. The gills are at first white and ultimately yellow. The taste is like that of kidneys.

'*White Fir Wood Mushroom,* A. dealbatus, fig. 23. Grows commonly in fir plantations, though occasionally elsewhere. It is smooth and white, very much like ivory. The gills are thin, white, and run down the stem.

'*The Champignon,* Marasmius oreades, fig. 24. Is one of the most common and delicious of fungi. It grows on lawns and pastures, generally in rings; but *never in woods.* The stem is solid and tough, the whole plant being of a light cream colour.'

'*Sallow Hunting*,' by J. Lea.

'To the unentomological, the subject of my paper, namely, Sallow Hunting, will probably convey about as much idea as snark hunting or some such amusement of a mythical nature; so I think I had better plainly state at once that Sallow Hunting means searching for moths on the blossom of the sallow. The occupation is a holiday one, unsuited for the term; and so this year, as our Easter holidays come too late, the sallow being now in flower, it must be given up. The tree in question is the Sallow or Palm, or as the botanists would have it, Salix caprea. The male and female flowers are on different trees, the former being a large bright yellow catkin, the latter a green catkin with less scent and colour, but equally attractive to moths. Last year, as Easter fell early, I had the opportunity of working the sallows in their prime, during the holidays; and I will endeavour to describe the trees, selected for operation out of a large assortment, as the most generally suitable. They were three in number, growing in a large hollow, surrounded on three sides by hills, but not too much enclosed to prevent the scent of the flowers spreading. One tree was a female, growing in an overgrown hedgerow, and the other two, which were males, stood side by side in what had once been a hedge, but now is a swampy ditch; they were all clear of bushes underneath, and were thus rendered convenient for the method applied for capturing the insects which swarmed on them. The operation commenced by spreading a sheet as smoothly as possibly on the grass underneath, and with a long stick hitting the part of the tree immediately over it. The moths then fell into the sheet, and had to be examined by the light of a lantern before they had recovered from their intoxicated state, and seemed likely to fly;—I might add that a common net is almost useless here. It would be inconvenient to be thus employed on a roadside or public path, where one would be constantly disturbed by inquisitive yet ignorant persons; but the locality I referred to is on no path, nor near any road, and I was only once interrupted by a keeper going his nightly round, who descended the side of the steep hill, some quarter of a mile out of his way, to make ample apology to his supposed poachers for having disturbed them, saying that it was his duty to see what the light was doing on his master's land: for naturally I was trespassing. But I must come to the more strictly entomological portion of my paper. For the choice of an evening, as far as the moths are concerned, there is no definite rule; on some nights, though apparently unsuitable for moths, the trees might be swarming; while on nights apparently propitious, there might perhaps be a single specimen of the commonest sort. Even while freezing there might be swarms of the common herd, but no good ones must be expected; so the best rule is to go every night, with the exception of wet nights, when it might be as well to stay at home for personal comfort. But now for the contents of the sheet. There are two

general divisions of the moths that are thus taken; these are, first, moths which frequented the ivy in the autumn, which have hibernated through the winter; and, secondly, all the spring Noctuas. Among the former one cannot expect to find good specimens, as a rule; but some rarities come occasionally, such as Exoleta, Petrificata.

'Among the common and usually found ones, are Satellitia, the great cannibal chestnut, and Vaccinii, the small red chestnut. The early spring Noctuas will naturally be good specimens, having just emerged from their chrysalises. The great genus Taeinocampa includes all of these,—in fact, every Taeinocampa comes except Lithorhiza, which is to be found on trees and palings, but not sallow. A short description, to further the instant recognition of some of the commonest sorts, might be useful to anyone wishing to handle the sallow, and so I will endeavour to give one here. A very characteristic irregular black spot in the centre of the fore wings instantly identifies Gothica: as also the twin jet black spots on Munda. A large dark grey brown moth will probably be Instabilis, but as the rarer moths Opima and Populeti are very like it, such a moth should be carefully examined and boxed if there is the slightest doubt. It should be remembered also that this is a very variable insect. Rubricosa, as its name implies, is a pinkish red, and it is distinguished by a clearly dotted costal margin. The commonest, Stabilis and Cruda, are of a pale brown colour; the former has a distinct transverse line and the discoidal spots clearly defined; the latter is very small, which is its chief characteristic. These are the commonest of spring Noctuas: while for the hibernated autumn moths, Satellitia may be distinguished by its larger size, the waved border of its wings, and its conspicuous uniform spot; and Vaccinii, which is a dingy red with blunt wings:—this latter seems to lose a great deal of its colour by hibernation, as at ivy it is red, and has become quite dingy by sallow time. Finally, as a safe concluding rule, box everything else indiscriminately. To all collectors the working of the sallow is profitable: the beginner may get complete sets of the commonest sorts, and these in good condition, besides a few rarer ones; and the more advanced collector has a chance of meeting with some decidedly good additions to his collection; but all who go should bear the precept in mind, "Blessed are they that expect nothing, for they shall not be disappointed."'

'*Spring and Autumn Flowers*,' by H. G. Wauton (c).

'The following paper is, with a few necessary amendments and additions, the result of my botanical researches for a Natural History Society in the south of Dorset, during the last months of the year 1876; and was suggested by the extraordinary contradictions, owing to the mildness of the season and the climate, of all my carefully-collected Rugby experiences of the dates of flowering in plants.

Written without any reference to books except Bentham's Handbook, I have allowed it to remain so, intending it to be rather suggestive than explanatory, and appealing for fresh facts rather than trusting to my own loosely linked observations.

'When does the Botanical year commence? Does it follow the Civil or the Ecclesiastical, or make a calendar for itself? A question easily settled perhaps in the Arctic circle or among the Grampians, but hardly so in our midland and southern counties, or further south on the borders of the Mediterranean. What are we to say to the fact that the common hazel nut has flowered *twice* this year, the next year's blossoms being fully in bloom before the first of January (for the first time within my remembrance)?

'Why are some plants (like the bramble) half-evergreen in our climate, some varieties being apparently evergreen, some losing their leaves quite early? Why too does the beech in the valleys retain its leaves, withered and dead, as if uncertain whether it were really necessary to part with them altogether? What means, lastly, our array of thirty or forty "all-the-year-round" flowerers which live and thrive all the winter through? It is sufficiently obvious, without looking to Mediterranean countries where the flowering seasons are almost inverted and the plants follow the rainy season, that they all follow the law of their own comfort, and flower when and as best they can and the climate allows them. Why the species which are simpler in construction and colour come first and are followed by those of higher development it is easy to see, and we have a long list of plants which are only a calendar of the increasing warmth and influence of the sun; but there are many which waver in their allegiance between spring and autumn, and some few which have curious counterparts in the two seasons, and which suggest a connection between themselves and the stragglers and loafers just mentioned which I wish to draw your attention to.

'It is well known that the flora of every country has been determined by the climatic changes at some time or other of the country they inhabit, but I do not think anyone has gone so far as to show how the flowering season has been affected in this way, or whether such change has played any part in the differentiation of species; or, lastly, whether any such modification can be traced as going on now before our eyes in any of our native species. Our own climate and flora are both strictly intermediate in character, and we may with some confidence look to them as at least giving us some valuable hints in that direction. Such I believe you will find in the two classes of native plants I have done my best to observe. They are (1) those which have spring and autumn counterparts, each with a well-defined and unvarying period of flowering, (2) those which have slightly defined counterparts or seem to be in process of making one, and which are apt to desert their recognised seasons.

'To begin with the second class, the links which shew the working of the system, I have carefully watched for the first ap-

pearance of the holly, the wild strawberry, the strawberry potentil, and the dog violet, four plants, all of which I have found out in the hedges this year on the first of November, the holly a little earlier, the strawberry in October; none of these are ordinarily due till some four or five, or in the case of the holly, some six months later. The primrose, on the other hand, which I believe to be of a more settled spring type, was not out before December, though the weather meanwhile was even milder. The holly I noticed was out or in bud only on trees which had either borne no fruit, or had it all nipped by the frosts of the early part of the year, and seemed anxious, as it were, to make up for lost time. The strawberry had a well-matured fruit at the end of October. Salix caprifolia was also out on several trees at the end of November on leafy side-shoots of the main stems. Were these plants feeling their way towards an autumn growth, such as others, I believe, have accomplished in very recent times?

'Again, the scented violet seems to me an instance of something more than an early growth. Its autumn form begins (though rarely in the wild state) to bloom about August, and if there is a real winter, it does not reappear in the spring edition until the first or second week in March. Here we must note that it is the more luxuriant garden form which flowers in the autumn, and that the white variety does not seem to be met with except in spring. Would a theory of the shifting of its flowering season account in any way for the strange phenomenon of the plant wasting its strength on the scented and petalled flowers which almost invariably prove abortive, and having to rely on the summer or cleistogamic forms for the setting of the seed? The violaceæ are a tropical family, numerous in the home of their birth, but in Europe represented by one solitary genus of few species: of these five species the sweet violet (v. odorata) is the earliest flowerer, two are little more than varieties of the same, and the remaining two (v. canina and tricolor) are the latest flowerers and set their seed, the latter invariably without recourse to petalless flowers, the former in a far greater degree than the earlier sweet violet. It would seem as if the sweet violet especially, from having been fostered in an early growth from remotest times, has not advanced yet to the knowledge its relatives possess, and is still from sheer force of habit wasting its strength in fruitless blossom, and on the other hand experimenting at the other end of the winter season, and attempting to solve its old difficulty by an autumn growth. It would be interesting to ascertain whether autumn violets have more tendency to set their seeds than the spring forms possess.

'My next observations were on the two closely allied forms of the gorse—Ulex Europeus and nanus—and the intermediate form U. Gallicus, which between them hardly leave any portion of the year unoccupied. Though the one is a pronounced autumn species, and the latter flowers *in the mass* in April, they are both out now together in this place (Dec. 20), the one just ending, the other just

beginning. The specific difference between them is of the very slightest—a smaller stature and flower, a few hairs less on the calyx, smaller bracts, and a more orange yellow in the corolla; and the difference between the autumn and spring flowerer is so slight as to only just constitute a doubtful difference. To add to this uncertainty, we have an intermediate form, of intermediate size and chiefly recognizable by the deeper colour, and I think we must allow that this autumn species is one of very recent growth:—indeed I rather think it is at this present time being brought about in the course of travelling from the west back again to the east where it came from, for I find by my own personal experience, and it is an acknowledged fact, that though the species run into each other a good deal, and the intermediate U. Gallicus is most prevalent in the west of England where the winter is of the Mediterranean type, the forms are far more distinct in the east where the winter is more severe. In other words, I should call the autumn form a Gulf-stream variety of more delicate and enervated habits which, having become accustomed to a winter flowering, is now finding itself compelled on passing the narrow zone between mild and (comparatively) hard winters to declare itself and become a true autumnal species.

'Passing on from this interesting species, I apply the same cause to certain other plants which I consider to have been differentiated in the same way, though more widely, by the wedge of winter. All that I can collect of these (which form my first class, viz., those that have a distinct and unvarying autumn counterpart) are the spring and autumn crocuses (C. vernus and nudiflorus), the squills (scilla verna and aut.), and I may add (M. annua and perennis) the two mercuries. I would begin by remarking that the effect of their choice is mainly shown in the extra-development either of form or colour, or both, in the autumn kind, and the comparative roughness and meagreness in that of the spring. The autumn gorse I have said is distinguished by the deeper and warmer colour both in corolla and branch; so, too, of the four crocuses (if we may include for the time the nearly allied Bulbocodium and Colchichum) the two autumn ones are of the richer colour, of a red purple and of larger flowers; of the two mercuries the one is an annual, more delicately and more luxuriantly constructed in all its parts, the leaves stalked and the stem branched, the other of rougher and coarser leaf and simple stem; of the two squills, the autumn one scarcely differs in anything but its longer stem and lengthened raceme, which in the spring one is starved down into a short and close corymb. Lastly, in each case the autumn species will be found to be the more decidedly western one of the two.

'Another curious set of facts, which I have not verified but give on a high authority, is the different habits of the leaves of the squills and crocuses. These seem not to have veered with the flower, but to follow an independent course of their own. The autumn crocus leaves come up with the spring species, but die down before the flower, and can therefore be of little or no use, it would seem,

in protecting the young ovaries. In the autumn saffron (Colchichum) they seem to have come to a sort of compromise with the new order of things, condescending to it so far as to send up leaves with the flower, but which do not assume their full proportions till the following spring. The autumn squill is yet more erratic, and it would seem hopelessly bewildered; for it sends up a tuft of leaves for next year's stem, but which die long before that stem has flowered.

'Will anyone who sees anything worth notice in the few facts I have thus laid before them observe any of these plants he comes across, and more especially the three species of gorse?'

'*Insect Transformations*,' by Mr. Sidgwick.

'As there is rather a dearth of papers this evening, I thought it might afford me an opportunity, in the absence of more interesting matter, of bringing before this society a few general remarks on the subject of transformation of insects.

'A few years ago, there was nobody to be found who viewed the transformation of insects with what I may call a philosophic surprise: all the world was divided into those who did not know of them, and the naturalists who regarded them as so perfectly familiar that they could not create any more surprise, or if they were disposed to feel a little astonished at so remarkable a series of phenomena, classed them with all the other 10,000 odd things which a naturalist is daily meeting. But the epoch made by Darwin's great book, and the new life given to the doctrine of development, have changed all that. We have got to examine again in the new light shed by this theory, and see whether any of the old difficulties given up as hopeless, or which had ceased to attract attention, have become at all unravelled, or are worse entangled than before. Among these old problems is the question of the transformation of insects. Let me just clear the way by stating the question as it is put afresh under the new circumstances.

'We suppose then all forms of life to start by being developed out of simpler forms: until we ultimately come back to the simplest conceivable form of life, whatever we may choose to call it. Each new organ, or new peculiarity, or new power which a higher species developes, is only then fully explained when we have shewn by what new circumstances its presence was made necessary, and by what accidental variations, continued through a long series of years and constantly added to, (the varying species being benefitted by the variation and so leaving a larger number of offspring than its neighbours,) the total change has taken place. This complete explanation has been naturally given for a very few cases, but in a vast number the gaps have been filled up so reasonably by shrewd guesses, that a great deal has been done towards understanding the problems of life better than before.

'This then being so, can the theory of evolution at all explain the transformation of insects? Suppose an original primitive form of life, how can simple development change it into a form which is not really one, but three (if not four) distinct types, which at first sight seem to have no connection with one another? Granting the egg or germ, which we see also in the fish, in the birds, and finally in the embryo of the mammal: still we are no nearer to explaining the transformations. Out of the egg in the other cases comes a small animal resembling the parent: a small fish, or bird, or mammal: and in the last case it grows even before it is born into a complete resemblance on a small scale of its parent-form.

'With the insect the case is startlingly different. Out of the egg comes a worm: this has—let us take the case of a common moth as a well-known illustration—this has sixteen legs, a soft fleshy body, a few or more numerous hairs, no wings, lives a sluggish life occupied chiefly in eating leaves for which its digestion is solely adapted, has no visible difference of sex, has no power of self-multiplication, and grows rapidly in a few weeks from a thing as big as a pin's head to a thing three inches long and as thick as a little finger.

'In the next stage what a difference! there is no locomotion: no feeding: no growth: the insect changes in shape, in colour, in size, in habits: it is brown instead of green, (to take a common case), lives for six months under the earth, and is absolutely motionless, except that it can wriggle its tail when touched. It is indifferent to temperature, seems to be able to endure a winter of any wetness or dryness, of any cold or mildness:—in fact in this stage it is a most uninteresting insect.

'In the next stage comes a still more surprising change, at least to those who feel bound to explain everything on the principle of evolution. On a sudden, generally in the night or early morning, out of this brown, dull, shapeless, lifeless thing, the outer shell being cracked, steps forth a soft, fluffy thing with four large veined powerful wings thickly clothed with scales and capable of very rapid flight: the body divided into segments and also clothed with very thick hair: with two long antennae or feelers in front, and two palpi: with a digestion adapted only to sugar from flowers, and therefore quite different from the digestion of the first stage or larva: with two distinct sexes, just as in the higher animals: and with an enormous power of multiplication, the female having as many as 500 eggs, in some cases, which she can lay.

'How can these things be? On the theory of special creation it is all easy: but it seems almost impossible to explain these facts in accordance with the theory of evolution. It is this question which I propose—not to answer, but—to throw some little light upon, if I can. I must premise that much of my material has been derived from a paper by Sir John Lubbock, which has recently appeared, but which has hardly perhaps attracted as much attention as it deserves.

'In the first place, then, let us keep the larva and the perfect insect or moth clearly before our eyes, and compare the two, and see whether any of the enormous differences seem to disappear under observation. And, first, as to the legs*. The moth has three pairs of well-developed legs, with joints and hairs and hooks, each pair being attached to the thorax segments. In most other insects, bees, flies, and beetles, &c., the legs are placed in precisely the same place, shewing that they are constructed on the same general plan. But the caterpillar has 16!—yes, but look at it a little closer, and you will see that there is a great difference to be observed: there are legs and legs, in short. There is the thorax with its three segments, just as in the type of a perfect insect, and on each of these three segments there are the two well-developed legs jointed, and clearly an organic structure of the right sort. But now look at the other legs. They are not legs to call legs at all: they are only fleshy protuberances, with no structure at all in them. They do not by rights bend or hold or poke: they are not limbs, but mere warts. How then does the insect hold by them? By mere suctional action; just as if a fat man press a rather warm hand on a piece of glass he will find it adhere. And, again, another strong argument to anyone who has studied the question of structure at all: these prolegs as they are called are very inconstant in their development, shewing that they are rather irregular organs, not belonging to the original plan at all. Thus in the whole family of geometers, the first six of these legs are wholly wanting*. This gives the insect a very peculiar method of walking, which is well known to collectors, and even to a common observer if he have his eyes about him, as so many of us have not. The caterpillar does not walk with the undulatory motion of the ordinary larva, but with an odd looping motion which causes it to assume the shape when it is bringing up its rear, so to speak, of the Greek letter omega. These are often called, from this, the loopers or omega caterpillars. Again, in the genus Cerura, or horntail, which contains the well-known puss moth and the little ones known as kittens, the last pair of these prolegs is wanting, being changed into two long red fleshy filaments, which it can jerk out so as to touch nearly any part of its person, and which give it a very formidable appearance to the first bird or boy that touches it.

'If we look at the other orders of insects we shall see these conclusions much strengthened. The larva of Sirex, one of the hymenoptera, has the regulation six thorax legs, but no prolegs at all, as it burrows in wood and does not want them. Another hymenopterous larva, that of the saw-flies, has the six legs, but all the prolegs, though rather differently arranged from the moths: indeed the young collector often mistakes it for a proper moth caterpillar: and in this case it is all right that it should have them: for it feeds upon leaves just like the lepidoptera, and wants the prolegs to hold on by.

* See Plate IV.

'Take the beetles. The genus Scolytus which feeds on bark has the regulation six legs: the asparagus beetle, whose habits are like moths, has also prolegs and looks like a moth larva. But the case of the bee larva is perhaps the most curious: it lives in cells, is well looked after, and no more wants legs than an Oriental monarch. Well, it has no legs, not even the regulation legs: but as if to shew that these are not so easily dispensed with as the prolegs, it has in the early stages, and only in the early stages, rudimentary legs on the right segments.

'Summing up, then, the argument from legs, we find that the thing which seems most permanent in the larva in the matter of legs is the presence of three pair of real legs on the three thorax segments: and that is just what appears to be the typical formation of the perfect insect. So that any differences which appear between the larva and the perfect insect in the matter of legs—and at first sight these seem to be very great—is seen on further inspection to disappear.

'But we have got a very little way at present towards explaining the great differences. Why does an insect go through the great changes from larva to pupa, and from pupa to perfect insect? The fact is, we must begin a little further aback. In the higher animals the process of growth is gradual from the first. But an insect always proceeds by stages. Whatever be the cause, the insect has to undergo a series of moults, and it often happens that while with the higher animals the changes which the more developed ones take on them are produced insensibly, the changes of insects occur at the time of their moults. Thus, to take the case of a larva only, it often assumes quite different colours at the later moults. In the first skins it is of a simpler kind, more what it was centuries ago, no doubt: its peculiarities do not appear till the later moults. Thus, to take a very simple instance, the different species of common hawk-moths are in the early stages of their larvae very much alike, while in the later moults they assume the distinctive characteristics. As an insect in the process of evolution gets further and further away from the primitive type, it still retains in its childhood its old form.

'Another great difficulty is the fact that the perfect insect—again taking the moths—has a sucking mouth, and a stomach capable only of digesting sugar and fluids, while the larva has a chewing mouth—quite different in structure—and adapted for leaves, and a stomach corresponding. How could one be developed out of the other?

'This is a very important point, and as yet has by no means been cleared up. But some few considerations make it easier.

'1. In the first place, granted that the change is to take place at all, it is clearly necessary that it shall take place suddenly: an insect cannot afford to have a mouth which is slowly growing from a biting to a sucking mouth, or it would starve in the process.

'2. There is a certain wingless insect called Campodea which has both sucking and biting apparatus: the jaws are retractile and

can be used when occasion requires. Suppose the original lepidoptera to have had some such instrument as this: and that it was clearly for its advantage to have its jaws at one time of its life strong, and its sucker at another: we should then find that its sucker would disappear from the larva state—be aborted—and its mandibles disappear from the perfect insect state. Then, as time went on, the stomach would adapt itself also, and the new state of things would begin with the perfect stage. And observe, natural selection would then be acting at two distinct points in the life of the beast: first, in modifying the jaws and stomach to favour the conditions of life of the larva, and then, in doing the same kind office for the perfect insect, in quite a different direction.

'3. We may observe that the change from chewing to sucking mouths is by no means the universal rule in the insect world. There are hosts of insects which have the same kind of mouth all through the various changes. For example, the whole tribe of the orthoptera, including the well-known crickets and grasshoppers, have the jaws all through: and indeed resemble the imaginary original insect very much more than the lepidoptera: you cannot say that a cricket has regular larva, pupa, and imago, like a decent moth or insect should have.

'Another point we will notice in the history of our moth, which throws some light on this hard subject. Whenever a moth's larva is going to change, it begins to look sulky, is off its feed, and often sits quite still for some two or three days. The young collector is at first unhappy about his pet: thinks it is going to die: but the real fact is, that as he is going to throw away his skin, his head, his jaws, and all the hairs, &c. that pertain thereto, he thinks himself justified in taking a little rest before such a large innovation;—in short, metaphor apart, he is only exemplifying the natural law that before great changes in the living subject, there is a period when external activity is quite suspended. Well, apply this principle to the still greater changes which the insect has to undergo at the last moult of all, and you get the main fact of the pupa or chrysalis state explained. Here he has no longer to change only his mouth, his skull, his skin and hairs and breathing apparatus, and a good deal of his colouring matter: that, after his experience as a larva, he thinks but little of: but also he must now get a proboscis, get a shorter but much fluffier body: he must put on four scaly wings: two palpi: two antennae: a digestion adapted to sugar only: and lastly, just as a boy has to choose when he gets into the Upper School whether he will do German or Science, so our insect on getting into the higher walks of winged life, has to choose whether he will be a male or female. It is surely allowable, when such changes as these are in progress, that he should have a little longer time to think about them: and so we get the motionless pupa stage. And a small point comes in here, to shew the enormous influence of external conditions on the changes of insects. You would have expected that all moths having about the same amount of change

to undergo, would have about the same time to do it in. And so, no doubt, they would if it were not for the external conditions. The time actually requisite, to judge from the shortest time taken, is about six weeks. Thus the drinker spins up about the middle of June—in fact, just now. He come out a full-fledged moth about the end of July. But now take the case of those moths which go down into the pupa stage about the middle of October. Allow them a little longer, as the weather is colder, and they would appear about the beginning of December. But it would not do at all that the poor moth should appear at that time of the year: it would not be able to enjoy itself in the evening as it does now. So the animal has developed the power of taking its transformation much more leisurely. It does not turn up till May, and this becomes an ingrained habit, and is not alterable by merely giving it a warmer temperature: for if you put them in a warm room and give them an artificial summer all the winter months, they still will take three times as long as the regular summer moths. In short, natural selection has acted upon them in this respect also, and they come out at that time which is for the benefit of their youthful family when it comes to life after they are dead.

'One more point, the wings: where did they come from? how did natural selection produce them: or were they not rather always there?

'Of course if we are right in our theory of development, the wings were not always there, but—however difficult the thing may appear—they were developed. But is there any explanation to be had of this, which is apparently the greatest of all changes the beast undergoes?

'Two reasons first there are, which to a naturalist are very strong, for indicating that the wings are a later addition acquired by development. 1. That there are wingless insects. 2. That the wings in all the insects which have them do not appear at first, but come on later in life. The principle is pretty constant in all animals, that the qualities and properties which they acquire late in their career as animals appear also late in their individual life as single beings, and conversely, what they acquire late in their individual life was not originally characteristic of them, but only acquired by the species through development. Apply this principle here, and we infer *a priori* that the original insect was an apterous being, and that the wings came later. Where did they come from? No one knows: but ingenious guesses have been made.

'There is an aquatic insect called Chloeon, whose larva has curious membranous flappers which are called branchiae, and which are used for breathing purposes. Now it is conceivable that a descendant of an insect like these Chloeons might have rather unusually large flappers, which might be useful for purposes of locomotion, although not intended originally for that. The vast advantage given to any mortal being by having an instrument for locomotion which its neighbours do not possess, is quite enough to

determine the development of these flappers as time went on into something much larger and more powerful than the original branchiae. Ultimately the insect we are imagining might be able to swim in the water better far than its neighbours, and so have a very decided pull in the race for life. Curiously enough, there is a beast called Polynema natans—which with the usual felicity of scientific names means the swimming swim-swim—which has distinct wings and which does use them for purposes of swimming. Well, suppose that, as time went on, our imaginary Darwinian insect, having reared a large family with finely developed flappers, and in fact rather set the fashion among the aquatic insects for flapping, and using the things meant at first for breathing for purposes of moving on the face of the waters—suppose, I say, this flapper to live in a pond which got dry: and that there was no other pond suited to the race of Chloeon within a reasonable distance. The good old Conservative Chloeons, who felt that what was good enough for his father was good enough for him, and who had refused to develope his flappers beyond the regulation size, would give up the struggle and the ghost simultaneously: but our friend with the developed flappers would at first proceed walking along the ground with what the poet calls the oarage of his wing: until suddenly the thought would take him as the grass was tiresome to walk over, why not try the air? a new discovery would have been made: the art of flying would have been invented: and more important still to our friend, the Chloeon with the big flappers would have saved his valuable life, got into a new pond, and handed down to his posterity the large flappers which had saved him. In fact, he would have been the first winged insect, and his descendants would have inherited his enterprising disposition, and his wings. We may be sure that an art so useful as flying would not be suffered to die out for want of practice: on the contrary, all that the succeeding generations would have to do would be to develope the wings so acquired to their best form and their most convenient size.

'If we want to know what the original insect was, we must consider the simple form of the larvae. He consists of these elements: a head: a thorax: a segmented body: six legs attached to the three segments of the thorax: breathing apparatus by spiracles down the side. [See Plate IV.]

'A great many of my audience are Conservatives: but the greatest Conservative in the world is a beast called Campodea, whom I mentioned before. The insect world around him were developing as the centuries went on all kinds of new ideas: wings, palpi, stings, hairs, bright colours—what not: they were changing so from childhood to old age—that is, from larva to imago—that they were not recognizable by the oldest family friends: but Campodea would none of this: his larva had always been the same as his imago, and the same he would remain. And there he is to this day to witness if I lie: and also to shew the inquirer what was the original type of insect.'

'On the Excursion of the Members to Seaton,' by G. Jones, (M).

'On Saturday, June 29, 1878, the members of the Society had their annual excursion. We went by rail as far as Seaton station, on the Market Harborough and Stamford line, under the guidance of the President and Mr. Gillson. Here we were met by the members of the Uppingham School Natural History Society, and Mr. Haslam (O.R.), with carriages in attendance. By these the whole party was conveyed under the new viaduct, by Harringworth church, up along the brow of the hills bordering the valley of the Welland. Leaving Barrowden down below us, we turned up to the right through Wakerley to a small wood just through this village. Here we all dismounted and enjoyed a most excellent lunch kindly provided for us by our three leaders. After this the various sections separated, to meet again at the same place. The Geologists found plenty of work on the spot, a quarry affording a section some 30 feet in height of the Lincolnshire Oolite. From this a *Lima* and several fragments of *Echini* and *Turritellae* were obtained. The Archaeologists adjourned to Wakerley church. Here were three bells. The church was a very interesting one, with a fine crocketted Perpendicular spire, interesting semi-Norman pointed chancel arch with Norman mouldings, fragments of Norman triforium (?), and a most singular altar-like Easter sepulchre. The Botanists and Entomologists also found their work ready at hand.

'After this the party re-assembled at the quarry, and we all started off again. We passed round Fineshade Wood, still going over the Lincolnshire Oolite. We came through Laxton without stopping, and thence down the hill to Harringworth. This was a most interesting part of the excursion. The Geologists dismounted, and traced the passage from the Lincolnshire Oolite through the Northampton Sand to the Upper Lias Clay. Then we came into Harringworth again at the cross. Next we visited Harringworth church. Here were many points of great interest. The following is a brief list: triple sedilia in chancel *and* in south aisle—the latter is a most unusual position for three sedilia, though one is not rare: fine late Perpendicular rood screen, much resembling the screen at Ashby St. Ledgers: sancte bell (out of place): beautiful Early English tower and spire, with very early Decorated spire windows: very well moulded north door with archivolt mouldings dying into the shafts produced above the capitals.

'The party then returned to Seaton station, where we separated from the Uppingham Society and returned home by our outward route.

'The thanks of the Society are due to Mr. Haslam, Mr. Gillson, and the members of the Uppingham Society, for their very great kindness to us and most excellent arrangements. This is the first joint excursion of the Society. It passed off so well that we hope for many more.'

'*Four days in Wicken Fen*,' by M. J. Michael, (c).

'Wicken Fen is one (very nearly the only one) of the old Cambridgeshire fens; it lies to the east of the river Cam, between Cambridge and Ely.

'Having had tea and got everything ready—the everything including a large two-burner duplex lamp, for you must know all the good things are got in the fens by light—it is time to set out.

'Once outside and past the two pumping stations, whose chimneys form a conspicuous landmark, you have the fen before you, separated only by a broad "Lode."

'How shall I describe the fen to you, and to what shall I liken it? Perhaps the thing that will describe it best will be to imagine yourself standing at "Swifts" and looking at the reeds and the river: imagine those reeds prolonged for an indefinite distance, mixed with tall grass and scrubby sallow bushes, and you will have some idea of the look of the fen. But in reality it is different: for in the first place the sedge is not so tall, but much thicker, and in the next it does not grow in the water but on comparatively dry land: and lastly, instead of a winding river, the "lodes" as they are called (a lode being a canal or ditch, according as it is navigable or not) are almost straight. In the part of the fen where you work (and real hard work it is too, as anyone who tries will find it, comprising as it does the carrying there and back a heavy lamp, besides your other apparatus, and then the standing watching it till two in the morning,) years ago there had been ditches cut to get the peat, for fuel; and these ditches partially overgrown and filled in, and with about two feet of water and ten feet of slime, form very insidious pitfalls to the unwary; of which more anon.

'Such then is the best description I can give of Wicken Fen: and indeed it must be seen to be appreciated, for the difficulty of steering about amongst the lodes (most of them too broad to be jumped) cannot be realised unless one has tried it.

'Now suppose you have arrived at your collecting ground, found a firm spot to fix your lamp-pole, put on your great coat, lighted the lamp, and settled yourself in expectancy, the natural question is, what do you hope to catch after all this preparation? There are, then, four great varieties to be caught in Wicken Fen, some of them to be got only there. By turning to page 311 of Newman you will see a figure, and not a bad one either, of a dingy brown moth called Hydrilla Palustris, and by reading his description you will see he says, "a single specimen is said to have been taken in Cambridgeshire, and another at Compton Wood." Newman wrote this about 1869. In 1872 (?) a certain gentleman, Mr. F. D. Wheeler (whose acquaintance I made while down there) tried the experiment of taking a lamp into the fen, and in addition to the other three I am about to mention, he caught several specimens of this extremely rare moth. Now when this became known, you may be sure other Entomologists availed themselves of this plan,

and even while I was there, no less than six lamps were burning in the fen, including that of Mr. Wheeler. In spite however of all these unnatural enemies, very few Palustris have been taken—in all about sixteen—and when I tell you that its market value is £5., you will see that it is worth taking some trouble to catch. The thing we next should like to get in while we stand under the Cam, looking eagerly out into the deepening darkness and mist, is a small micro, Nascia Cilialis, which is also very rare. Another of the four is figured in Newman on page 268, Meliana Flammea: the fourth and last being Macrogaster Arundinis, some specimens of which are in the Society's cabinet, I think. While you are pondering over these and other things, and are wishing for something to come, your wish is realised. There's something, and off you dash after it, feeling sure that it is Palustris at least. But oh! *why* did you forget that there was an old peat cutting in that direction? you stumble forward and sink, making one despairing swoop with the net, and all is over. Rather I should say all is to begin: you shout for somebody to come and pull you out, for one leg is above the knee in the slime, and the other is sinking fast; and while you wait for assistance you are able to study capillary attraction as the water soaks slowly up your shirt. Having been dragged out, your first care is to box your capture and examine it, and you are not pacified to find that it is Exclamationis. Your next half hour is spent in trying to scoop the mud out of the instep of your boot with a dry reed that keeps breaking, and in washing your stockings, thinking the while that life is but a delusion and a snare.

'By this time your companion comes back from sugaring the reeds, and your hopes revive when you see he has made a fair bag of game, nothing rare however. So to get warm you take a turn of going round the sugar. Presently, about 12 o'clock, you hear a shout, "I've got one." "What?" is then shouted by less fortunate watchers: and envying you hear the answer, "Palustris, a beauty." You then make a long *detour* to the lucky man's lamp, for although it is only about 200 yards off, on account of the above-mentioned peat cuttings you cannot go straight across to it. When arrived, you see probably for the first time in your life the great rarity, and, as I have said before, insignificant enough it is. They fly about half-past eleven to half-past one, and come sneaking slowly just over the top of the sedge. The best way therefore to catch them is to have a sheet spread on the ground just under your lamp, and if possible another lamp just the height of the sedge: if you can't manage that, a small hand lantern placed on the ground will light the sheet up sufficiently to see anything that crosses it.

'After the sight of that Palustris you go back to your lamp, breaking down the sedge and the tenth commandment in a very discontented state of mind; for the wind is getting up, and the moon has come out, so you may be sure nothing else will to-night. However, you stop, in the hope of occasionally diversifying the

monotony—and there is a good deal of it—by chasing Mirothastri, of which there is also a good deal, to try and get the perfectly white variety Urticoe.

'At last you give it up—shut up shop—and tramp home, your boots creating an oozing thereby giving you an unpleasant demonstration of the theory of the common or garden pump. N.B.—It is wonderful how many lessons in Mechanics you pick up in the fens.

'The following are the things taken: those starred I have duplicates of.

'N. Rubi.	*M. Fasciuncula.
N. Plecta.	*P. Lignata.
N. C-Nigrum.	A. Rumicis.
H. Oleracea.	A. Segetum.
H. Pisi.	G. Trilinea.
H. Atriplicis.	A. Basilinea.
Not. Camelina.	*A. Unanimis.
S. Clathrata.	*A. Gamma.
F. Atomaria.	*N.Strigilis (the dark fen form)
*C. Exanthemaria.	M. Flammea.
*C. Cubicularis.	P. Machaon.'

'*On certain Ice-borne Boulders scattered over the summit of "Norber," near Clapham, Yorkshire*,' by Mr. T. N. Hutchinson.

'In my rambles in the West Riding of Yorkshire during last summer vacation, I came upon a magnificent collection of ice-borne boulders or "erratics," a slight notice of which may be interesting to the Geological members of our Society.

'Of course it is well known that the great valleys of Yorkshire were once traversed by vast glaciers, which have left unmistakable marks of their presence in the numerous striations still visible on many of the limestone ridges, in the deposits of Boulder clay with which the rock-surfaces in the valleys are more or less covered, in the numerous moraine heaps left on the retreat of the great ice masses, in the rounded outlines of the hills so conspicuous in many parts of the Ripple Valley and elsewhere, and especially in the numerous blocks or "erratics" with which the surface of the country is so frequently strewn.

'Erratics of moderate size are common enough on the hill-sides and scars throughout the whole of the Limestone district, but nowhere have I seen them presenting anything like so striking an appearance as on one of the outlying spurs on the south of Ingleborough, locally known as "Norber," rising as a fine cliff behind the little village of Austwick, about six miles north-west of Settle.

'The limestone strata of Norber and the adjacent scars rest, as is well known, on the upturned edges of Silurian rocks, consisting

of grits and slates which are well exposed in various quarries in Ribblesdale, in Crummock Valley between Norber and Moughton, and elsewhere.

'Huge blocks of these dark Silurian grits and slates appear to have been transported by ice to their present position on the limestone cliffs of Norber. They can be traced over a distance of nearly two miles and may be counted by hundreds. In size they vary from blocks of about a cubic foot to huge masses weighing many tons, of ten, twelve, and even fifteen feet in some directions.

'The boulders are most thickly strewn on the surface of a limestone plateau. Here they lie tumbled about, often close together, in all conceivable positions. The greater portion are supported on blocks or pedestals of grey limestone of varying height, from a few inches to two or three feet, or even more. These rock pedestals are often hidden by the growth of tall grass or ferns, but they may generally be discovered upon closer investigation. I have made a few sketches of some of the more remarkable forms. One block, about ten feet high (shewn in fig. 1, Plate I.), is seen to rest on three small columns of limestone. Another, of the same height (fig. 2), is not unlike the celebrated Idol rock at Brimham.

'It would be an interesting problem to determine how long a period has been necessary for the waste of the limestone by atmospheric agencies to the average depth of these pedestals, as such a time must have elapsed since they were originally deposited upon the plateau, the disintegration of the supports themselves having obviously been prevented by the shelter afforded in consequence of the overhanging portions of the boulders.

'The sketch on Plate II. shews some of the scattered blocks on the nearly level plateau looking in a S.E. direction towards Swarthmoor. Moughton Scar is on the left, and the cliffs above Feizor on the right.

'The boulders extend over a large portion of the hillside rising above this plateau, and also on the lower slopes of Norber, nearer to Austwick. Some are perched on the very edge of the cliff. One especially attracted my attention, as it is difficult to understand how it can have retained its place, leaning as it does actually over the edge of the cliff. A sketch of this boulder is shewn in fig. 8, Plate I.

'The fine boulder shewn in the lower part of Plate II. is from another locality. It lies on Winskill Scar, above Langcliffe, about two miles from Settle, and is the largest erratic in that neighbourhood. Its position is very striking, seen, as it is in the sketch, with Ingleborough and Moughton Scar forming a splendid mountain background.'

'*Attractions for Moths*,' by J. Lea.

'The subject of my paper to-night—Attractions for Moths—must be divided into two general heads, namely, natural and artificial; and of these, the most widely distributed is the former.

Under this head, first and foremost, come Sallow for the spring, and Ivy for the autumn; but having recently dealt with both these as subjects for papers, I need only mention them here. Then, throughout the summer, various flowers, garden and wild, attract a large number of moths. It would be needless to run through a list of flowers to be searched, as almost every flower is said to produce some. Flower beds in general are worth an occasional glance, though three or four very common species, notably Plusia Gamma, will probably be the result; but it should be remembered that convolvulus hawks occasionally come to petunias. Veronica, a tall purple-flowered plant, produced some six or eight species in very fair numbers last holidays, though mostly common ones. On some clematis, too, I have noticed regularly every year swarms of the Feathered Gothic (Popularis), besides a sprinkling of other common ones. Leaving garden flowers, we come to the herbs, which sometimes repay a look, though I have never taken very much from them. For wild flowers, Ragwort, (especially, I believe, by the sea), Valerian and Heather are among the most productive. Some say that the male plant of the mistletoe is even more attractive to the early spring Noctuas and Geometers than sallow: I have never tried this myself, but I should say that it was only attractive when there was no sallow in the neighbourhood: moreover, that it would be very often difficult to get at.

'Fruit is also attractive to moths; for example, the Large Yellow Underwing (Pronuba) has a most decided liking for strawberry beds: and over-ripe blackberries are often productive of several species.

'I have left till the last of natural attractions, perhaps, the two most important of all. First of these I shall mention the bred female, which, when exposed in a gauze covered box, often entices its own males, time and circumstances propitious. The best known, though by no means the only example of this attraction, is the Common Vapourer, which, on a sunny autumn day, may be exposed often to great effect. And, lastly, there is a centre of attraction which is not as well known as it deservedly should be—namely, the berries of the yew. The sweetness of these could hardly fail to attract the attention of moths, though perhaps this would not strike all entomologists. They are ripe in August, a few weeks before the ivy is out, and one finds on them the late summer Noctuas and some of the early ivy moths. Several rarities have been reported as taken from them, but I have not met with anything really good in this way. Anyhow it is a very interesting method of taking moths. One can see them without any light, for their eyes are most conspicuous in the dark: but of course a lantern is needed for identifying. It would be waste of time to mention all the different ways of taking them off, for these must be adapted to the size and shape of the tree. Shaking or beating them into a sheet is very undesirable, for the berries fall off very easily when ripe, and the moths cling tightly on to the sprigs of yew on which they sit while enjoying their repast. Such then is the first part of my paper.

'Of artificial attractions, there are only two chief kinds to be dealt with. Of these, I shall first speak about Light. One of the most necessary points for success this way is, that the light should shine out in a favorable direction, towards trees or some place where moths might be expected to be flying. The light or lights should be placed close to the window, which on a still night might be opened: but one can entrap them just as easily keeping the window shut till they appear. Then, should a moth appear in such a position that on opening the window it would not come in, one can sometimes use the candle as a magnet, and by passing it slowly along close to the window draw the moth into a favourable position. Some moths, especially Geometers, make straight for the candle, and are not contented to settle till they are obliged to do so through conflagration of their wings, which is most undesirable for their captor. Others on entering make for their shadows on the ceiling, and amuse themselves with hunting it till they are caught themselves, which is not so easy to do as one might imagine. Of course if the moth can be secured in a chipbox when settling outside on the window, so much the better; but this is seldom possible. Some say that moths do not come into light till 9 or 10 at night, but I have often seen them indoors almost immediately after dark. Mr. Greene in his "Insect Hunter's Companion" gives a lively description of the results of a good night's work at light, which might interest anyone wishing to try this. "About 1 o'clock in the morning, the collector's room presents a truly curious, not to say formidable, appearance. It literally *swarms* with insects: I say insects, for almost every order is represented. There are gnats, flies, beetles, bugs, fleas, centipedes, ichneumons, midges, spiders of all kinds, earwigs, &c. &c. One feels almost bewildered. What with the ceaseless hum of insect life, half-a-dozen moths perhaps on the window, another half-dozen apparently dashing out their brains against the ceiling or careering through the room, while others are whirling about in dangerous proximity to the light, the collector is often at his wit's end." "This," he goes on to say, "is most exciting and delightful," though perhaps we shall not all agree with him here.—But in speaking of this "setting to work" to attract moths by light, I should mention that by occasionally looking into any large and well-lit room, such as our house halls and dormitories, etc., several moths may be observed flying about, which, if preserved from the treatment of wet towels which they often receive, may turn out sometimes to be well worth having; though I admit Large Yellow Underwings come in very freely. Then gas lamps and specially lighthouses attract moths to a large extent; but one does not care to climb the former, and it is not everyone that can get at the latter.

'The second and most important artificial attraction is Sugar, which almost everyone who calls himself a collector must have employed. As regards the mixing of the drug, I have read the receipts of several entomologists, and every one says that his own

is the best. For my part, I do not think that it much matters. Raw sugar, or treacle, mixed with some beer and a teaspoonful of whiskey, makes a mixture which I have found to succeed as well as could be expected: but I will refrain from saying that this is the best, as I have never tried any other: so that I cannot compare it. Rough-barked trees are the best ones to put the sugar on; the reason for this being that the sugar lasts longer on them, and does not soak in as it does on palings, etc.; but anyhow it must be placed out of the wind. It is convenient to have a round of sugared trees, about ten or fifteen yards apart; but of course one cannot always meet with what one wants in this respect. So much then for the application of the sugar. As for the result, I am not prepared to lay down any conditions under which one can be sure of success. Having read much on the subject, and having had a fair amount of personal experience, I can see no reason why one should expect moths at sugar more on one night than on another. My first experience of sugar was more or less of a success: at least there were several kinds of moths there, some naturally new to my collection, such as the Copper Underwing, which with several other moths is taken almost exclusively at sugar. For the next two years next to nothing appeared, at least not enough to make it worth while sugaring often, though time of year, material, and locality, were just the same as before. This year, however, was more successful even than the first year. It was curious to notice the almost total absence of certain moths that had come freely before, such as the Heart and Dart (Exclamationis), and the Old Lady (Maura): then too the appearance in swarms of others this year which had not appeared at all before at sugar—for example, the Square Spot Rustic (Xanthographa), and the Flame Shoulder (Plecta), and a few others. This is only another instance of the comparative scarcity of insects one year, which might abound plentifully other years, as was mentioned at our last meeting. A few words on the behaviour of these nocturnal revellers might not be altogether out of place here. Most of them become stupified, and fall off insensibly when touched, after the first few sips: but hours of drink could not reduce Polyodon to this state. He however may as well be frisky as he is not often wanted. But then it should be observed that the Red Underwings (Catocalae) are always ready to fly at any moment of alarm; so also are all Geometers, and some care is required to procure them.

'Hitherto I have said nothing about the atmosphere, which I agree with many others is far more likely to be the reason of failure than any usually assigned. As a very fair example of favorable atmosphere, I think my own experience for the first three nights at the ivy last holidays will serve my purpose. The first night there was a cold wind, making the occupation personally rather uncomfortable, and giving one the idea of an unfavourable night, as far as the weather was concerned. However, the moths came in very fair numbers, with one or two good ones. The second

night was warmer, without any wind—in fact just the sort of night when a large field might be expected; as it was, perhaps half-a-dozen very common specimens was the result of the evening. The third night was more uncomfortable than the first; cold and very misty, almost raining; but yet this night suited the moths, and very good captures were the result. This then is the sort of night for sugaring and moth-hunting in general: for light, just before and during a shower of rain (when the moths seek shelter) is perhaps specially good. For other attractions little is to be said: on palings and trees when the morning sun shines one often finds moths: and perhaps I might mention, out-houses, barns, and even cellars as attractive retreats: every year I notice about two dozen Herald Moths, together with a few tissues, in the cellars at home, which have come there purely to hibernate, and not attracted by alcohol in any way. I might also mention moth traps, but I know nothing about them, except that they cost more money than they are worth, and I have heard that they do not succeed in their intention; therefore they scarcely ought to come under the head of Attractions for Moths.'

'*The Bee Orchis*,' by Mr. Cumming.

'Most observers must have noticed the irregular appearance of certain plants, making it easy in some years to secure dozens, when in other years it would be hard to find as many single specimens. I have selected Bee Orchis for our consideration this evening, because it is a plant I have long watched and experimented upon, and because of all plants it is one the least likely to be overlooked. A beautiful object in itself, and one which the least observant is not likely to pass by without noticing. Moreover, it is rather a prominent plant in our Rugby list, being one of the few orchids with which we are favoured here, and one which seems specially partial to the stiff clay and limestone which form the canal banks as well as the sides and bottoms of old lime pits. Accordingly, although the thing in certain seasons is far from rare, I have never either found or heard of it a hundred yards from the canal banks—generally on those banks themselves. My personal acquaintance with it in this neighbourhood is slight. The first summer I was here (*i.e.* three summers ago) I neither saw nor heard of it, possibly because I did not then know where to look for it. In 1877 it was found by several members of the School on the grassy canal bank opposite the towing path between Clifton and Hillmorton, not far from the bridge by which the road from Hillmorton to Clifton crosses the canal. The specimens seen and collected, I think, would have numbered dozens. Last summer (1878) I and several members of the School hunted this piece of bank over and over again without finding a single specimen, although in many places the same bank was literally ablaze with Purple Orchis (O. Maculata)

and Twayblade. The Bee Orchis, however, was found in considerable abundance both on the canal bank between Newbold Tunnel and the bridge by which the Harborough Road crosses the canal; and also in two old lime pits close to Newbold Wharf. Turning to the Rugby Register, which extends over the years 1871—75, it is recorded in four years out of the five, but no localities are given. We have then this fact, that the orchis appears almost every year locally, the localities in successive years being entirely different—separated by a mile or two. Perhaps some of my audience will be disposed to say, so much the more shame to me and my botanical friends who constantly root it all up—for my part, I can plead guilty to no such indictment; I doubt myself whether I have in the two years dug up three roots; and I believe my botanical friends who visited the habitat have been fully as moderate.

'This freak of the Bee Orchis, however, is by no means a solitary instance of the same sporadic behaviour. I used at Cheltenham to search two localities very diligently every year for Fly Orchis, the next species to the Bee Orchis. One year I remember finding about a dozen specimens scattered about in a certain wood. For three or four years, speaking from memory, I did not find a single specimen, and then again it appeared in some plenty for so rare a plant.

'Another orchis, O. Morio, which grew plentifully in a meadow outside the same wood, was certainly some years in great abundance, and in others scarce, though always to be found. Yet another instance from the same family. Seven miles from Cambridge runs a long artificial chalk ridge, on a smaller scale, but similar to the Devil's Ditch at Newmarket and at Brighton. On this bank grows, or grew twelve years ago, a variety of rare wild plants, including the Pasque Flower or Danes Blood, together with Bee and other Orchids. This was a favourite haunt of mine, and for several years I paid it several visits each summer. One certainly as near Easter as possible for Pasque Flower, and another in June for their seed, and for another orchis (O. Ustulata). This orchis showed, I well remember, extreme variability in its appearance. I have seen it there in such complete profusion over the sloping bank, that it could have been mown down by a scythe like grass in a hayfield; at another, a walk of a mile or two along it produced hardly six specimens.

'To return to our Bee Orchis. From Fleam Dyke and elsewhere, I have constantly tried to transplant Bee and other Orchids. Some flourish in a garden border (which must not be disturbed by the spade) remarkably well. Bee Orchis proved with me till this year a complete failure.

'Two years ago, in the month of January, I happened to be walking with a friend over a very favourite Bee Orchis habitat—the grassy top of Leckhampton Hill, near Cheltenham—certainly thinking of anything rather than Bee Orchis. Seeing among the

grass a little rosette of leaves, I at once recognised them, and on returning home we sent out some of the children of the household to dig up for us a series of plants, as they were really much commoner than I had ever seen the flowers in the same locality. Three of these I brought home and planted in my alpine garden at home, and as they died off during the summer without flowering, I expected to see them no more. Last spring, however, the same three plants reappeared, and in the present summer even sent up a spike of flowers, which from some cause unknown to me never developed. There, however, the plants were alive their second year, contrary to all my previous experience on, I can safely say, dozens of different plants. Is there any difference in the circumstances to account for it? There is just this difference. On former occasions, having always observed the plant growing among grass, and wishing to reproduce conditions as natural for it as might be, I had always taken up with my plant a good tuft of the sod, and transplanted it, sod and all, into my garden; while, on the latter occasion, the children had dug it up without any sod at all. The difference the sod makes I take to be this. In its natural state the plant grows in grass, but amongst grass on dry banks where the grass is thin and stunted. When the grass is transplanted into comparatively rich garden soil, it flourishes so vigorously as to choke the weaker plant entombed among its roots, either dead or dormant. I then thought dead—and accordingly the tufts of grass were left year after year while hope remained, and were ultimately thrown away. I now believe that the tubers of the orchis were alive and dormant in the tufts of grass. Although I have no evidence as to this orchis, I remember receiving some specimens of Moonwort (a plant very close to the ferns), which favours moist upland pastures, as the Bee Orchis favours dry hilly pastures, also contained in tufts of grass natural to it. The tufts of grass grew vigorously, but the Moonwort never reappeared. Thinking the plant dead, and intending to turn out of my garden the grass tufts, I in a vacant way pulled them to pieces with my hands, and found in every one of them a healthy crown of the lost plant. That is a long time ago; and as far as I remember, I was foolish enough to throw the plants away, never dreaming that their real enemy was most likely the very grass I thought so essential to their existence. Although the evidence I have to offer is imperfect, having been collected accidentally through many years, I venture to suggest the conclusions that the Bee Orchis and many other plants with thick fibrous and tuberous roots are able to suspend vitality for one or for a series of years, until circumstances favour their appearance above ground.

'Beyond this, facts hardly justify me in going; but I will even suggest the possibility that many plants send up leaves during the winter and early spring—at a time, that is, when the grass is least vigorous—enabling them to carry on the process of nutrition even when they may be able comparatively seldom to send up flower

spikes. I am led to this conclusion by the firm persuasion I have that I have never seen the plant so abundant as on Leckhampton Hill in January.

'This seems to me the only way of accounting for the irregular appearance of the plant as here on our canal bank, and I am particularly anxious to have a record of the exact spots where the plant has been or shall be found, so as to learn at what sort of intervals, regular or irregular, it returns to the same spots.

'It also accounts fully for the very irregular appearance of many of our rare orchids and other plants, and rather gains support from the fact that some other bulbous and tuberous plants have been known to reappear, or at all events to appear of their own accord, in places where they have not been known for centuries. I refer especially to the appearance of the Gladiolus in the New Forest whenever the forest is cleared and broken up, and to the appearance of the Saffron Crocus at Saffron Walden, in Essex, in soil removed for the foundation of a building.

'Since writing the above I have noticed in my garden that two out of the three plants referred to are already above ground—for them the spring of 1879 has already dawned.'

'*Note on Monstrous Campanula,*' by Mr. Wilson, [see Plate 7].

'A monstrosity of the Canterbury Bell. The stem is flattened, about $\frac{3}{16}$ by $\frac{1}{8}$ inch. There are ten distinct sepals to the outer envelope, two opposite pairs somewhat overlapping, as *a*, *b*, in the side sketch. No junction was visible in the outer corolla, but there was a depression in it at the junction of the sepals. The number of united petals of the outer corolla was twelve, all nearly regular. Of the two inner flowers, the nearer had five regular petals, and was quite normal except that one of its stamens was petaloid, very slightly. The further flower was irregular in petals, having six, but not of uniform size. Several of its stamens were petaloid, and their extremities are just seen in the sketch. The colour of the outer and inner corollas was normal.

'*July* 7, 1878. 'J. M. W.'

'*Dissection of the same,*' by Mr. Cumming, [see Plate 5].

'*a*. Shows the expanded outer corolla having a petaloid expansion growing on its surface (*g*). In this corolla stamens are entirely absent.

'*b*. The expanded inner corolla belonging to one of the two central flowers. It has two petaloid expansions (*h*, *k*) on its surface.

'*c*. This flower had five stamens, one of them being attached

to the style which was curved over as shown, and bore a perfect stamen on its under curved surface. This style had six distinct stigmas, and a dissection of the ovary showed five carpels, some of them being rather rudimentary.

'*c*. Attached to the filament, which was adherent to the style, was the corolla—like expansion (*c*) which bore two apparently perfect stamens, and apparently the rudiments of more, as shown by the finger-like processes.

'[I could not make out certainly whether this supplementary corolla was coherent by its opposite edges, as the flower was rather withered].

'*d*. The second internal flower was normal as far as its corolla and stamens were concerned, except that the two stamens shown were enlarged as to their filaments, but not distinctly petaloid.

'*f*. The pistil in this flower also had one stamen adherent to it, and was curved over, as in the preceding flower. It had six stigmas, and a section of the ovary showed six carpels.

'The two enclosed flowers had their ovaries quite distinct from each other, with the exception of an adhesion along one of the sutures.

'The examination of some double garden campanulas shows that they become double by reduplication of the corolla, each of the internal corollas being gamopetalous, and fitting one within the other, like a Japanese box. This may throw some light on the origin of the curious organ (*e*).'

On '*the Dodo*,' by T. B. Oldham.

'In 1598 there was a shipwreck; the ship was a Dutch merchantman; it was wrecked on the coast of the Mauritius, which up to this time had probably been uninhabited by human beings. *Exitio mare nautis*, many of the Dutchmen soon found out; but a few managed to escape. As these unhappy wights, worn with the weight of their weariness and woe, travelled slowly inland in search of food, they encountered 'herds,' so to speak, of unwieldy stupid birds. These were Dodos, or Drontes (see Plate 6). They were almost the only visible means of subsistence, and at last, though most reluctantly, the sailors were compelled by absolute necessity to kill and eat them; for the flavour of the Dodo was most unsavoury, and could not but be distasteful, even to Dutch sailors.

'In 1638 a living Dodo was brought to London, and a drawing made of it, which is now in the British Museum. Where, and how long this one lived, or where, and how he died, I do not know.

'In 1644 colonists were sent to the Mauritius, who also would seem not to have been very fastidious; they continued the work of slaughter, and, according to all accounts, eat 'meat untold' of the Dodo.

'*In* 1693 *there was not a single Dodo in the whole Mauritius.* The Dodo had disappeared; eaten off the face of the earth by Dutch sailors and others, only his bleaching bones were left to tell the tale. And the tale they tell is a mystery; for some great naturalists, who have examined them, class him with the Vulturidæ; others with the Columbidæ.

'And this great bird, this vulture pigeon, or pigeon vulture, was only known to man as a living creature for ninety-five years. Alas!'

On '*Aquariums*,' by L. Carleton. We extract the following.

'I will now describe the three best, but at the same time the three rarest kinds of snails.

'1. Paludina Vivipara. This is a snail with a shell somewhat resembling that of the common garden snail, but with four distinct white lines converging to the point at the top of the shell. This snail possesses two marked peculiarities, which distinguish it from every other species; *viz.*, it produces its young in the form of a very small snail with a complete shell, and not first as an egg like other snails; and secondly, it has a small door turning on a hinge, which, when closed, completely shuts up the mouth of the shell.

'2. Planorbis Corneus. A snail with a shell like that of an ammonite; it sometimes grows to a good size.

'3. Planorbis Carinatus. Like No. 2, but not so large.

'Of these three species No. 1 is considered the rarest; last May, however, I found plenty of them in the canal between the Hillmorton Locks and the Clifton Road: I cannot account for this, as they are generally not to be found near Rugby.

'No. 3 I find is rather common in the old canal near the Hillmorton Locks.

'No. 2 is to be found in various parts of the canal, but it is rather rare near Rugby.

'They are all about equally good as scavengers, but No. 1 is the most interesting to keep.

'If you value your snails, do not keep leeches in the same aquarium with them. Last term I noticed that the snails in the aquarium in the Natural History Society's room were gradually dying off. For a long time I was unable to discover any reason for this; but at last I succeeded; for one day I caught the leech sucking the blood of a snail that he had just killed: of course this sort of thing would never do, so the miscreant leech was instantly taken out and executed. I need hardly add that after this righteous execution the alarming mortality amongst the snails entirely ceased.

'Crayfish also are capital scavengers; they are easily caught by feeling with your hand in the crevices between the stones in the bank of the canal; they nip rather ferociously, but the enthusiastic naturalist should not mind that. They cast their skins once in a

year, the cast-off skin looking at first sight exactly like a live cray-fish. The chief peculiarity about them however is, that they invariably swim backwards, *i.e.*, tail foremost. Two or three are quite enough for one moderate-sized aquarium, as their appetites are extremely capacious.

'I do not think that caddis grubs are worth getting; they lie like bits of stick on the bottom, and are moreover very destructive to the plants, devouring the leaves as if that were all that they were made for. Shrimps are not of much use as scavengers, for the simple reason that fish have a great liking for shrimp flesh, and so the poor shrimps are invariably gobbled up the first time they show themselves: however, they make up for their shortcomings in the scavenger line by furnishing very good food for the fish.

'Avoid mussels; for they die very easily, and then make the water foul.

'And now a few remarks as to the number of fish. One fish to three quarters of a gallon of water I consider about right, up to eight gallons; but after that, one to every four gallons:—by a fish, I mean one of four or five inches long, for you may have almost any amount of minnows and sticklebacks. Be careful not to have too many plants, for if they are crowded together they will not grow so well; but of course the number entirely depends on the area of the bottom of your aquarium: one plant for every five square inches would be quite sufficient.

'Now let us to the river side and see which fish are the best suited for stocking our aquarium with: for that is all that remains to be done. Though I have placed this part last, it is by no means the least important; sometimes indeed it is even the most difficult of all: but it chiefly depends on the locality in which you live, as it is extremely difficult to transport fish from a distance. The best way to catch small fish is with a hand-net; but where this is not practicable, they may be caught with a hook. In a small stream great numbers may often be caught by fixing the net in a narrow passage and driving the fish down into it.

'The best varieties for an aquarium are perch, roach, gudgeon, carp, pope, minnows, and sticklebacks. You should try and procure as small specimens as possible, about three or four inches long, as they are more lively when young than when old. The seven varieties that I have mentioned are all very common, so a description of them is unnecessary.

'The perch is one of the handsomest of freshwater fish; unlike all other fishes of prey, perch are gregarious, always swimming in shoals. The great drawback in keeping perch is, that they have no compunction as to cannibalism, and consequently the minnows lead a hard life.

'The roach is a slender, but very graceful fish; like the perch, it is also gregarious; but it does not prey upon fish, like the latter.

'The gudgeon is a small fish, seldom growing to more than a few inches in length; owing to its preferring to lie on the bottom,

it is not so interesting a fish to keep as those that I have already mentioned.

'The carp is a somewhat sleepy fish; in its habits it closely resembles the gudgeon.

'The pope is a most amusing little fish, as it is always of a most ferocious nature.

'The minnow is a very pretty, innocent-looking, fish; minnows are gregarious, always swimming in large shoals. They look very pretty in an aquarium, if you can procure a large number of them, which generally is not difficult.

'The stickleback, so-called from the three sharp stickles or spines on its back, which are capable of being elevated or depressed at pleasure, is deservedly popular with all observers of nature, on account of its undaunted pluck and general beauty: it will attack, and drive away by its pertinacious assaults, a fish far larger than itself. All fish construct a nest of one kind or another; the stickleback, however, surpasses them all in architectural talent: it builds its nest of blades of grass, bits of straw, and such odds and ends as it can find; the materials selected being always of the same colour as the surrounding objects, in order to avoid detection as far as possible; and hence it is that a stickleback's nest is so seldom seen. The eggs are exceedingly small, and are yellow when first laid, afterwards turning to a darker colour.

'The stickleback will defend its nest with marvellous determination and courage, never allowing other fish to intrude on its domain. Although, however, sticklebacks display such praiseworthy pluck in defence of their nests, there is no fish so destructive to their eggs as the stickleback itself; if you throw some of their eggs into the water, they will immediately devour them. Sticklebacks are to be found in most of our streams and ditches, where they may easily be caught with a small hand-net.

'Of the seven varieties that I have mentioned, the hardiest, and consequently the easiest to keep in an aquarium, are the perch, the roach, the pope, the stickleback, and the carp. There are a few other common varieties of fish which may be kept in an aquarium, but they are for the most part uninteresting: such are the stone loach, the miller's thumb, and one or two more. The great peculiarity in the two last mentioned fish is that they are entirely unable to swim; they wriggle about on the bottom in the most helpless fashion, and it is with the greatest exertion that they manage now and then to wriggle up to the surface of the water, from which elevated position they always descend considerably quicker than they went up. However, the stone loach with all its ugliness is not entirely useless: if you ever feed your fish on bread, you will, on the contrary, find it very useful in eating up the bits that have fallen to the bottom unnoticed by the other fish: for, excepting the carp, fish generally will not eat bread lying on the bottom, unless they happen to be very hungry; and so the stone loach, by eating this bread, prevents it from befouling the water.

'I once caught a small trout in a stream by the Barby Road: I have more than once seen small trout in streams near Rugby, but I never before succeeded in catching one: how they get into these shallow, out-of-the-way streams, I am at a loss to explain.

'Some years ago I caught a little pike, about six inches long, in the Avon; I put it into my aquarium, where it lived very healthily for several months; if was unfortunately killed, however, by the water freezing over one night during the winter. I may as well here mention a most interesting peculiarity in the teeth of the pike, which has only recently been discovered by Mr. Charles Tomes. I give his own words: "The hinged teeth with which I am acquainted have certain characters in common; they are all capable of being bent down by very slight pressure, but in a single direction only; to force applied in any other direction, they are rigidly immovable. This direction, with certain variations, is inwards and backwards towards the gullet, so as to facilitate the ingress and the swallowing of food; on the removal of the pressure, they rebound to their upright position."

'This quite explains the wonderful faculty that the pike possesses of swallowing a fish nearly as big as itself.

'I once kept a small eel in my aquarium; but it was not of much interest, owing to it always hiding itself during the daytime in the gravel and under the stones.

'Certainly there are some marvellously curious animals to be found in our common rivers and streams. A few months ago I caught an animal in Clifton Brook which I at first sight took for a piece of thread; indeed I cannot give you a better idea of what it is like, than by telling you to imagine, if you can, a piece of black thread, about eighteen inches long, curling and wriggling about like a snake. I do not know whether these animals are common, but I have never seen one before, nor have I been able to find out what they are called. How such a creature could have any life in it at all is of itself a wonder.

'Perch will not touch sticklebacks ever, though they invariably devour all the minnows. The sticklebacks owe their good fortune to the spines which Nature has most kindly placed on their backs.

'Carp, as a rule, feed on bread, worms, etc., and do not prey upon other fish. One day, however, I found one of my carp swimming about with the tail of a stickleback projecting from its mouth. The effect was extremely ludicrous, though, no doubt, by no means pleasant for the parties concerned. How the stickleback got into this very uncomfortable position is a matter for conjecture: probably while darting about it unfortunately dived into the huge, gulping mouth of the carp; at least I should not think that the carp tried to eat the stickleback; at any rate, if it did, it will not try the same trick on again, I fancy. I pulled the stickleback out, and found it quite dead; the carp, however, swam away, to all appearances as well as ever.

'Newts are rather interesting to keep; they can easily be ob-

tained from most ponds by means of a hand-net; they are most abundant however in the ponds in brickyards. The males may readily be distinguished from the females by a fleshy frill along the back and tail; the latter have none. They change their skins once a year. Last June the two newts in the aquarium in the Natural History room cast their skins; but I am of opinion that each of them cast more than one skin, as they remained on a stone projecting out of the water for quite a month. It was very interesting to watch the process; the newt gradually peeled the old skin off, beginning at the nose, and working down to the tail, by struggling and rubbing itself against the rock-work and the side of the aquarium; it seemed to experience considerable difficulty in freeing its legs of the old skin; but after a good deal of kicking the persevering animal successfully accomplished its object, appearing in a skin, to all appearance, perfectly serviceable. The next thing the newt did was to eat up the old skin! Fancy eating an old coat that you had been wearing for a year. But there is no accounting for tastes; so let us hope that the newt enjoyed his dinner. . Owing to this peculiar habit I am unable to say positively how many skins were cast: I should fancy there must have been two or three, however, as the newt remained on the stone, looking quite parched and shrivelled, for about a fortnight after I saw it cast its skin.

'Many people declare that fish have great ears for music; whether they have or not, I cannot say; but I should be inclined to think not.

'It is a common but, unfortunately, a false belief, that fish will live in an aquarium for any length of time without being fed: it is true that they can live for a considerable time, but they are sure to die in the end, especially if you do not change the water, because, of course, they derive a considerable amount of food from the minute insects in the water. The best food for fish is dough, broken very small, and little worms; the red kind, known as brandlings, being most liked. You should sometimes give them a few live shrimps, as they are particularly fond of them. The best way is to get shrimps when you can, and keep them in a separate vessel, feeding them on shreds of raw meat; you can then give the fish a few at a time, when necessary.

'I should have mentioned that the best way to catch crayfish is to tie a piece of meat (raw) on to a string and throw it into the canal: the crayfish cling to the meat, and by pulling it up gently, as many as half a dozen may often be caught in one haul.

'I need hardly add that cleanliness and plenty of fresh air are absolutely necessary, if you wish to keep your specimens healthy, and your aquarium in general interesting and pretty to look at.'

A few remarks on the '*Geology of the Neighbourhood of Rugby*,' by T. B. Oldham.

'In describing a place, one is naturally led first to mention its

prominent physical characteristics, its mountains, its valleys, its rivers and brooks, and the general nature of its surface deposits, before proceeding to the actual enumeration of the various physical, geological, and palaeontological characteristics of the sub-strata.

'*Physical Geography*. At Rugby we are situated on the northern edge of an elevated tableland or plateau some 370 ft. above the level of the sea. This plateau slopes very gradually away to the west, having no decided boundary in that direction; on the north-east it is distinctly bounded by a slope forming the southern side of the valley of the Avon and Clifton Brook; and on the south it terminates abruptly in a steep escarpment overlooking the broad valley of the Leam and its tributary Rainsbrook. From this plateau many small spurs jut out northward and southward, forming small lateral valleys. It is in a valley of this description that the village of Lower Hillmorton is situated; while the villages of Dunchurch, Thurlaston, and Bourton, occupy respectively spurs stretching southward into the valley of the Leam. The other principal high-grounds are those on which Brownsover and Clifton are situated, and the hills of Barby and Kilsby. The river Avon flows through the valley between Brownsover and Clifton, and turning sharply to the west, forms the valley separating the Rugby plateau from Brownsover. The Clifton Brook flows through a narrow valley between the high grounds of Clifton and the extreme east end of the Rugby plateau, and joins the Avon just below the bend. The valley of Rainsbrook separates the Kilsby and Barby highlands, which are connected by a curious edge, called the Ridgeway, from Rugby, and runs into the Leam 2 miles south of Dunchurch. The only other valley of any importance is the lateral valley occupied by the brook Kedron, which flows past the back of the Victoria Works and joins the Avon just south of Newbold.

'*Surface Deposits*.—But over all this country there is scarcely a single spot, so far as I know, whether on the tops of the plateaux or in the bottoms of the valleys, where the actual substratum crops out at the surface, unless it be as the bed of a river or a brook, no where, except I believe on the top of Barby Hill, is that upper layer of drift we know so well, absent. It may be 1 foot thick, as the red glacial clay at Limestone Hall, or the gravel at Lower Hillmorton; it may be 50 feet thick, as the sand and gravel of the Lower Hillmorton Ballast Pits, as the blue glacial clay of the Clifton Road Railway Cutting, or as the red glacial clay of Newbold Hill, and the Cathiron Lane Tile Works; but it still is there. We have, then, an almost universal extent of superficial deposit, and these beds are as varied as they are universal: in a few yards their character as well as their thickness will often entirely alter. Moreover, there is an essential general difference between the deposits of the hills and those found in the valleys, which will be pointed out when the latter are described. The high level beds Mr. Wilson* has brought generally under the following 3 classes.

* Quar. Journ. Geol. Soc. Lond. Vol. 26, p. 199.

'I. A sugary sand, containing about 5 per cent. of chalk.

'II. A clay drift, containing pebbles of striated chalk.

'III. A gravel drift, with pebbles of flint and quartzite.

'These divisions seem very distinct and simple,—sand, gravel, clay; but when you come to examine the beds themselves, you find every gradation between each of these classes. Number I. is the sand shown so well both in the village of Lower Morton and in the ballast pits, and at Bromwich's Pit, New Bilton; it also includes the red sand of the Lawford Road below Butlin's Mound,* and is of a date contemporaneous with the glacial clays of class II., being sometimes found above and sometimes below them. Under this latter class come both the blue glacial clays of the immediate neighbourhood and the district east of Rugby, and the red glacial clays of the country to the west. These two drifts are quite contemporaneous, as is shown by the section on the Lawford Road, printed in the Society's Report for 1874, and only owe their difference of colour to a variant origin, the blue being derived from Lias rock, and the red from the Trias or Permian. Besides the colour, there is very little difference; but the red drift is generally more sandy than the blue, and contains a considerable number of quartzite pebbles; also, owing to its more sandy nature, the striated chalk pebbles which characterize these drifts are pulverised, and so become less apparent in the red than in the blue drift. But this sandiness is not entirely confined to the red drift, as may be seen at the Bilton Road pits, where, owing to the sandy, and therefore porous, nature of the drift, the chalk pebbles have been so finely reduced that even grains cannot be detected, and the presence of chalk can but be shown with acid.

'The flinty and quartzose drift† (No. III.) is perhaps the most widely distributed of all, and always overlies both the sand and clay drifts. But care must be taken to distinguish between this drift and a mere local patch of gravel occurring in the glacial sand. A careful examination will soon show the difference, for very little, if any, quartzite will be found in the gravels of the glacial sand, which will also contain many more fossils, and those in better condition, than will be found in the Quartzose or 'Northern' drift. This quartzose gravel varies very much in its character, and it will be found that when the stones are large, as at Pinfold's Pit, New Bilton, or at the Long Lawford Works, they mostly have their longer axes vertical, and fossils are rare; but when, as at Parnell's Pit, New Bilton, the stones are small, they generally have no distinct arrangement, and fossils are more frequent.

'But there is one other drift which will come under none of these classes exactly; it is the peculiar so-called "Oolitic" drift of Brownsover. This is well shown in a small pit‡ in the middle of a field on the north side of the road from Brownsover to St.

* An old British tumulus on the south side of the Lawford Road, just at the top of the hill.

† Generally known as the "Northern" drift.

‡ Three sections of this pit are given in Rep. R.S.N.H.S. 1873.

Thomas's Cross. It consists of distinctly false-bedded layers o sand and gravel, containing pieces of oolitic and liassic rock together with oolite and lias fossils, with a large quantity of chalk pebbles in which a cretaceous fossil or two may sometimes be found. Curious yellow nodules like those we find at Hillmorton* are also found in it, and layers of carbonaceous matter are often interstratified with the layers of sand and gravel. It is the most fossiliferous of all our drifts, and occurs, besides at Brownsover, at Coton House, and Brinklow Station; it used to be worked near Newton, but these pits are now disused.

'*Surface Deposits of the Valleys.*—When we get down into the valleys, however, we meet with a superficial deposit of totally different character—the alluvial mud and gravel. In these gravels the bones of extinct mammals are often found. They have been found at Lawford in the Avon valley, at Birdingbury in the valley of the Leam, and near Newton. The bones at Newton were found by Mr. E. Cleminshaw, but as Messrs. B. R. Wise and E. B. Lowe found in the same beds a bottle, stated by Mr. Matthew Bloxam to be of 17th century date, the bones were presumably rather *recent.* But of these alluvial beds undoubtedly the most famous are those overlying the Planorbis shales in the old Newnham Works on the north side of the road between Little Lawford Mill and Kings Newnham, where Dr. Buckland found the bones he described in his *Reliquiæ Diluvianæ*, consisting of those of Elephant, Mammoth, Horse, Ox, and of the first Hyaena ever found in England. This gravel would seem to be a high level bed, corresponding with that through which the Avon flows at Little Lawford Mill, in which bones of Deer, &c., may often be found.

'This alluvial mud and gravel lies immediately on the Lias in all our valleys, I believe, except at Hillmorton, where the valley deposits are striking in their singularity. In the immediate neighbourhood of Hillmorton Church, and for some distance round, the valley is occupied by a peat bed varying from 2 ft. to 6 ft. in thickness, which may be seen in ditches and the banks of the brook. The church is built on an island of firm land in the middle of the peat. At the bridge over the canal, a bed of sand is seen which rests on the peat, and Mr. Wilson† has shown that in its turn the peat rests on a quicksand, which has been traced as far down the valley as Butler's Leap. The peat does not extend far down the valley, and when it thins out, it is replaced by the ordinary alluvial soil.

'*Fossils of the Surface Deposits.*—The fossils in the drifts, otherwise than those derived from previously existing formations, are few. Besides those found in the alluvium at Lawford, the only others yet found here are the bones which in 1875 Mr. Wilson found at Kings Newnham. They were found in the glacial clay, along with some small shells, and were pronounced by Professor Boyd-Dawkins to be those of Reindeer; unfortunately, owing to

* Vide infra, p. 44.
† Report R.S.N.H.S., 1869, p. 32.

Mr. Wilson's absence at the time, they were lost in being sent back. Mr. Searles Wood, junior, is indeed stated to have found Ostraea edulis in the ballast pits at Hillmorton; but this is not at all improbable; they are quite common; I have often found them. I have seen them deposited there by the neighbouring villagers from the top of the pit.

'Such is a short general sketch of the superficial deposits of the neighbourhood. With regard to their age, it is very difficult to make any statements.

'*Age and Origin of the Surface Deposits.*—All that can be said is, that the glacial clays are older than the so-called 'Northern' drift, the flinty quartzose gravel drift; and that complete contemporaneity exists between the red glacial clays, the blue glacial clays, and the chalky sands. Of the direction from which they came just as little can be said; the quartzite stones and the chalk pebbles would seem* to show two entirely opposite origins for the clays, while the origin of the gravels is still harder to ascertain. Apparently the blue and red clays are derived from rocks in the immediate neighbourhood, whereas the gravel would seem to have come from a much greater distance off.

'*Industrial Uses of the Surface Deposits.*—For industrial purposes the surface deposits are a good deal used. There are large ballast pits for the railway at Lower Morton, which show a fine face of sand and gravel, where many good examples of cross-bedding or contemporaneous erosion may be seen. In the village, also, there are a good number of small private sandpits. At Brownsover the oolitic drift is dug for gravel, and at Coton House it contains such a quantity of oolite and lias rock that it is sometimes burnt for lime. There are also very large tile yards in the red glacial drift, on the north side of the Oxford Canal, near Cathiron Lane; there is a very fine section here, about 60 feet thick, of this red clay, containing striated blocks of chalk, coal, magnesian limestone, and inferior oolite.

'*Erratics.*—Before leaving the surface deposits some account ought to be given of the 'erratics' of the neighbourhood. There is a large boulder of yellow micaceous sandstone half embedded in red glacial clay drift on the north side of the Trent Valley Railway, just beyond Newbold; it is 3 ft. 6 in. long, 14½ in. wide, and 18 in. high, and lies with its longer axis NNW. and SSE.; none of its visible faces are striated. About 50 yards NNW. of this one lies a very much smaller stone of red syenite, measuring 12 in. × 15 in. × 9 in. On the south side of the Leamington Railway, just beyond Dunchurch, there is a block of grey granite measuring 31 in. × 27 in. × 28 in. On the right hand of the road to Little Lawford Mill, through Holbrook Park, just before leaving the park, there used to be a boulder of red syenite embedded in the red clay,

* We say 'seem,' for this conclusion would only be drawn on first thoughts, and from the *present* extension of the chalk; it is however well known that its extension was once far greater than it now is, and there is no reason against supposing it to have existed to the N.W. of us.

measuring 17 in. × 10 in. × 9 in. At the Bilton Road Pits there used to be two large blocks, one of grit, the other of red syenite; I have not got the measurements; the one of grit, which was the larger, was stated to be at least 350 lbs. in weight, and was striated longitudinally. In the Cathiron Lane Works there are several large blocks of rock, one of inferior oolite measuring 2 ft. 3 in. × 1 ft. 9 in. × 13 in.; this block is well striated. And in the Church Lawford Railway Cutting there are several large striated blocks of limestone.*

'*The Substrata.*—In the substrata we have all the beds of the Lower Lias capped near Crick and Barby by the Marlstone, and overlying the White Lias at King's Newnham, Lawford, Stretton, &c.

'*Middle Lias.*—The Middle Lias is very well exposed in a cutting for the new railway near Crick, where its junction† with the lower lias is very well shown. It is a very siliceous and micaceous marl with beds of soft micaceous sandstone. Patches of conglomerate are frequent, which would seem to indicate a shore deposit. Shells are very common in it, but difficult to get out in good condition. Avicula pectinoides, Belemnites elongatus, and some large pectens, have only as yet been found. The Marlstone beds also cap Barby Hill, but are exposed in no workings.

'*Lower Lias.*—The Lower Lias immediately below the Marlstone is a hard and very micaceous blue clay, containing many fossils. The principal of these fossils are Leda rostralis, Goniomya rhombifera, Cardium truncatum, and some large serpulae. In the same beds at Kilsby Tunnel, Ammonites Ibex, and Inoceramus dubius have been found. The beds are best shown in the same cutting as the Middle Lias through the hill at Watford Lodge. The beds immediately below these are shown in a cutting lying between Kilsby and Old Watling Street. Still descending, the next exposure of beds is at Lower Morton, where about 13 or 14 ft. of slightly micaceous blue shales may be seen. Near the top of the beds there are one or two layers of curious yellow nodules, composed of concentric layers of a very hard yellow clay. They are called fossil fruits by the workmen, and have been stated‡ to be coprolites, but their structure would seem to make this supposition untenable; they are apparently merely concretionary nodules. Next to these beds comes the Montlivaltia rugosa zone, which is shown at Hillmorton and at Catthorpe. The band in which the Montlivaltia is found is only about 1 ft. 6 in. in thickness, and occurs near the bottom of the Hillmorton Pits. About 8 ft. above it is another layer of the yellow nodules, noticed above as occurring at Lower Morton. The fact that Montlivaltia rugosa has been found at Catthorpe is of considerable importance in local geology, with

* Some of the blocks along the side of the Lawford Road seem to have originally come from the Church Lawford Railway Cutting; they are easily distinguished from the many blocks of road metal, by their rounded form, often striated sides, and by their composition, as they are all red syenite, the road metal being Hartshill rock, metamorphosed millstone grit.

† Since this paper was written, Ammonites capricornis has been found in the blue shales below the brown micaceous marl, here called Middle Lias. The palæontological boundary of the Lower and Middle Lias does not therefore agree with that which the physical characteristics of the several beds would seem to indicate.

‡ Reports, R.S.N.H.S., 1867, p. 27; and 1868, pp. 43 and 44.

reference to the theory of the Hillmorton fault,* for it proves the existence of distinctly Lower Lias beds on the north-east of the supposed line of fault. Of this fault the mean downthrow was calculated to be at Hillmorton 120 ft., and at Brownsover 700 ft., bringing in the Oolite, which the oolitic drift of Brownsover was supposed to represent. Now even if this drift were a patch of Oolite, which the presence of chalk pebbles would seem to render impossible, it is hard to conceive that Lower Lias beds could exist so near to it as they do at Catthorpe without the help of a second fault. However, a theory is generally easier to disprove than to prove, and the very abrupt termination of the clay at Hillmorton still remains unexplained; and yet it is not impossible that it may be the steep side of some old prae-glacial valley.†

'What we may call the Ammonites Dudresii zone comes next, and is exposed at the old Rugby Works and at the Toft Clay Pits. The principal fossils are Ammonites Dudresii and Bucklandi, and Unicardium cardioides. The Rugby Pits have now been disused about two years, and are almost entirely overgrown; but in the Toft Pits there is a very good section of the beds, showing some striking contortions, the beds being bent back over themselves (Plate). Below these come the beds shown respectively at Upper New Bilton, Bromwich's Pit, and at Lower New Bilton, Parnell's and Pinfold's Pits. They are beds of a firm dark blue clay, abounding in Ammonites semicostatus, and Pleurotomaria anglica. Fine specimens of Avicula inæquivalvis may also be found, with occasional specimens of Avicula papyria and Aechmodus' scales. At the bottom of Pinfold's Pit there is a band of limestone, which is the highest of the fine series shown so well at the Victoria Works and at Newbold. At the Victoria Works there is a magnificent section of interstratified clays and limestones, from which nearly all our Saurian remains come. Most of the Saurians have been found about 20 ft. from the top, on the north side of the anticlinal. Rather above this, about 14 ft. from the top, there is a thin band of fine shale, almost entirely composed of Avicula papyria, which sometimes contains ribs and bones of small Saurians. The most common Ammonite here is Ammonites Conybeari: but none are very common. At Newbold the beds are of just the same physical character, and apparently lie immediately below those at Victoria. In them Saurian remains are less frequent, and Cidaris spines and a small species of Ammonites angulatus are very common. Below these beds we have no outcrop till we come to the thick limestone band which forms the bottom of the brook which runs under the Trent Valley Railway, south of the high road from King's Newnham to Newbold. This is apparently the 4 ft. band of the well section by the Water Tower, and is characterized by Lima Hermanni,

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* Vide Report, R.S.N.H.S., 1874, p. 8.

† It is true that a very slightly increased dip (about 1 in 85) would bring in the Hillmorton beds at Catthorpe; but then, lying between Brownsover and Catthorpe, we should find the whole range of beds from Oolite to Lower Lias; no traces of which are to be found in the general appearance of the country, or in the beds of the Newton and Shawell brooks.

which has hardly been found elsewhere in our neighbourhood. This is the lowest limestone bed in the Lias, and from it down to the Rhaetic there are about 20 feet of blue shales, in the lower part of which Ammonites planorbis is found. These Planorbis shales are best shown at King's Newnham; they are coarse and not very fossiliferous shales, containing many layers of selenite crystals. They are also exposed at Long Lawford Works (where they are beautifully contorted), at Stretton-on-Dunsmore, at Limestone Hall,* and in the Church Lawford Railway Cutting. They lie immediately on the White Lias, a band of limestone from 6 feet to 8 feet in thickness, very broken and shelly at the top, but becoming firm and hard for the lower 2 feet. It has been stigmatized as unfossiliferous and uninteresting, but this must have been owing to want of patience in the observer, for in it have been found no less than 15 distinct species of fossils, having among them the most interesting fossil ever found near here, the Ophiolepis Damesii, which has only been found twice before in the United Kingdom. This White Lias is shown very well at King's Newnham, Long Lawford, Stretton-on-Dunsmore, Birdingbury, in Church Lawford Railway Cutting, and in the bottom of Church Lawford Brook. The most common and characteristic fossils are the Annelid shells, which are tolerably common, and, I believe, *only* found in the White Lias.†

'*Industrial Uses of the Lias.*—To the economic value of these Lias beds we almost entirely owe the abundant opportunities we have for observing them; if it were not for our brick yards and lime pits we should know very little about the ground we tread on. Bricks and tiles are made of the clays, and lime from the limestone. At the Victoria Works, hydraulic cement is made of the limestone, which was in great request when the Thames Embankment was being made. But the limestone at Victoria alone will yield this cement; in most cases it is only fit to burn for lime.‡ The White Lias, however, at Church Lawford, has been used as a building stone, but, owing to its softness, it does not weather well.

'Such is the Rugby Lias. Ten years ago a geologist§ in the school wrote, "There is still much to be done and much to be discovered." Ten years afterwards, in 1878, the same precisely may be said. The Rugby Lias cannot be worked out in 10 years by any number of observers, however energetic they may be; and it still offers, to any who choose to accept, attractions unrivalled in the interest it possesses, the enjoyment it gives, and the extent of the field yet left for discovery. 'T. B. OLDHAM.'

'*The School Collection of Insects,*' by Mr. Sidgwick.

'It is desirable that the facts about the Entomological Collection

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* A small farmhouse to the south of Church Lawford.

† There is a specimen in Warwick Museum, labelled Newbold, but I think it should be Newnham.

‡ Pits have just been opened on the Newbold Road, where cement is made.

§ E. Cleminshaw, Report R.S.N.H.S., 1868, p. 37.

which the Society possesses should be put upon record, not only on account of the interest which the workers in the Society naturally feel in knowing about the gradual progress of their work from the earliest days of the institution, but also because the value of such a collection depends to some extent upon the proper authentication at any rate of the rarities which it contains. And as I am the only person in Rugby who knows all the facts about this collection, I have ventured to take an opportunity, when there is not much to be done out-of-doors by Natural History students, to put these facts together.

'When the Natural History Society was founded in 1867, Mr. Kitchener asked me to assist the Entomological Section, and in default of any one really qualified by knowledge I consented to do so. The attention of the Section was immediately directed to making a collection of British Lepidoptera. As a nucleus of a future collection, four contributions were made soon after the formation of the Society. First, there were some insects kindly presented by Mr. Wratislaw, of Bury, a staunch Old Rugbeian, and an indefatigable Entomologist. The insects which came from him are marked W. Secondly, there were some cases sent by the Rev. J. W. Hayward, Flintham, Notts, who has been a great benefactor to the Society at various times. His presents include the greater number of the butterflies, amongst which is the now obsolete Large Copper, which at the time when Mr. Hayward presented the cases was still to be caught in the fens of the Eastern Counties. These are marked H. Thirdly, there were some cases purchased by Mr. Wilson from Mr. Edmunds, a well-known Rugby naturalist on the Lawford Road, and presented to the Society. On Mr. Wilson's claims to our gratitude I need not enlarge. And fourthly, there was my own private collection, which, stimulated by the prevailing spirit of generosity, I presented to the School. I am bound however to damp your ardour by confessing, that though it contained a good number of moths, they were not very valuable. I also gave the cabinet, which was made for me, when I was a boy in the XX., by Mr. Over, of High Street, for £3. Prices have risen since then. The glass, which was essential to the proper preservation of the cabinet, was not put in till they were given to the School. I may be pardoned for saying that perhaps a certain historical interest attaches to my part of the collection, though not otherwise precious, inasmuch as it was mainly formed at Rugby, when I was a boy in the School, from 1853 to 1859.

'These four collections were put together to make the Rugby School Natural History Society's Entomological Collection. We began with an intention to have two separate collections, one of British Lepidoptera, the other local. But the local one had to be in cases, while the other was in the cabinet: and the cases got so damaged that they had to be abandoned. It requires care in taking down, opening, examining, shutting, and putting back. And to expect five different kinds of care from every associate in the Society, every time he looked at them, was surely visionary. The

box system, and with it the separate local collection, had to be abandoned. It was found simpler to distinguish the local species by a separate red R., pinned alongside the specific name.

'The collection was no sooner formed than it began to receive assistance from the members and associates of the Society. It is impossible to record the names of all the benefactors, but I will do my best to omit no name of importance.

'G. B. Longstaffe, (G. B. L. in collection), now a distinguished doctor, was one of the first energetic workers and liberal donors. He was himself an enthusiastic collector, and many of the specimens in the local list rest on his sole authority, which however is unimpeachable.

'J. M. Lester, now a London clergyman, did good work and helped us much. His energy, however, was more in the observing and paper line.

'D. A. Ogilvie, Album-keeper, whose sad premature death is in the recollection of some members of the Society, gave some assistance to the work.

'In 1871 and 1872, A. F. Buxton held the Album, and filled several gaps in the collection by donations, besides giving valuable assistance as an energetic observer.

'In 1874 and 1875 H. Vicars was the chief worker in the Section, and under his auspices a great advance was made in the collection. He not only undertook and carried through to the end, along with myself, the tedious and thankless labour of gumming the names into the empty drawers, in the spaces destined hereafter to receive moths, but also gave his whole private collection to the School, with a rare and laudable public spirit, and assiduously collected then and since in our interests.

'In 1876 and 1877 H. F. Wilson, the late Head of the School, succeeded; and some of his private stores also were placed at the disposal of the Society. The present Album-keeper, J. Lea, has been most assiduous in looking after the collection, and has also been liberal with donations.

'A. J. Solly and G. A. Solly have from time to time made us presents, and otherwise helped in the work, and we have ground for hoping that the present representative of the family will keep up the name.

'I must not omit to mention one who has perhaps been the greatest benefactor of all, Mr. W. C. Marshall, now a rising architect, who for ten years has constantly sent us donations of moths, as well as interesting and amusing papers.

'His insects in the cabinet are distinguished by the letter M. attached, and those of the other donors by their respective initials.

'I may remind the Society, in conclusion, that a collection of insects soon becomes valueless if it is left alone, for the dust to corrupt and the mites to break through and steal. The long series of workers I have mentioned have all assisted in this task, and lately it has become an established customs to overhaul the whole collection at least once in every two terms.'

Meteorological Observations.

January.

Date	Barom. Reduced	Temperature				Rain — inches	Date	Barom. Reduced	Temperature				Rain — inches
		Dry Bulb.	Wet Bulb.	Max.	Min.				Dry Bulb.	Wet Bulb.	Max.	Min.	
1	30,316	34,6	33,8	43	31	,01	18	30,494	39,6	39	44	39	,01
2	30,350	43,6	43,2	46	33	trace	19	30,472	40,6	40,4	45	38,4	
3	30,243	41,4	40,4	47	35	,53	20	30,285	45	44	52,2	38,2	,02
4	29,936	46,8	46,6	47	44		21	30,045	51,6	49,2	55	49	,30
5	30,199	41,4	41,2	42	39	,01	22	29,985	47,4	47,2	52,4	46,6	,10
6	30,032	43,5	43	45	40		23	29,743	37	34	42,4	36	,01
7	29,578	34,5	34	44,4	34	,07	24	29,531	34,6	33	40,4	33	,05*
8	29,836	36	35	41	35	,01	25	29,424	28,4	26,8	35,2	28	,09*
9	30,234	33,6	33	37,4	32,6	,01	26	29,956	31,8	31,2	40,4	30,4	
10	30,330	32,6	31	38,2	31		27	30,086	33,2	33	43	29	,37
11	30,617	31,6	31,4	45,6	30,4		28	29,699	41	41	43	33,4	,13
12	30,655	33,4	32	38	33	trace	29	30,082	32	31	41	29	
13	30,514	40,4	39	46,4	35,2	,02	30	30,297	28,2	26,2	40	25	
14	30,361	45	44	50,6	42,4	,01	31	30,509	31	30,2	40,2	26,6	
15	30,287	48,8	47,4	52,2	46	trace							
16	30,219	45,6	44	50	43,2	,01	Average	30,155					Total
17	30,419	38,4	38	46	38	,01							1,77

* melted snow.

February.

Date	Barom. Reduced	Dry Bulb.	Wet Bulb.	Max.	Min.	Rain — inches	Date	Barom. Reduced	Dry Bulb.	Wet Bulb.	Max.	Min.	Rain — inches
1	30,617	26,4	26,2	39,8	26	,02	17	30,161	46	45,5	58,4	45	,03
2	30,452	36	35	40,4	31,8	,01	18	30,054	42	40,8	56	41	trace
3	30,468	37,2	36,6	41,6	35		19	30,440	37	36,5	47,2	30,2	,02
4	30,566	38	37,4	41,8	37	trace	20	30,205	43,4	42	47,2	37,4	trace
5	30,624	38	36,6	38,8	36		21	30,577	38,4	37,5	50,2	35	
6	30,576	31,6	31	33,4	31,2		22	30,617	45	44,2	49	43,6	
7	30,615	30	29,6	45	28,2		23	30,441	43,5	42,5	47	43	
8	30,624	26,4	26,4	46,2	25		24	30,253	43,5	42	47,8	41	,05
9	30,373	31	30,8	32,4	26,4		25	30,117	43,3	41,6	49,6	41	trace
10	29,990	34,2	34	38,4	31	,05	26	30,088	44,6	43	50,4	41	
11	29,979	35,2	35	45,8	32,6	trace	27	29,894	45	43,9	51	45	,31
12	29,234	34,4	34	40	30	,21	28	29,864	47	45,8	53	45,2	,18
13	29,906	42,6	42	43,2	32,2	,29							
14	29,840	42,7	42,7	47,2	42,6	,16							Total
15	30,065	38,8	38	49,6	35	,10	Average	30,280					1,43
16	30,217	40,5	40	49,2	39,8								

March.

Date	Barom. Reduced	Dry Bulb.	Wet Bulb.	Max.	Min.	Rain — inches	Date	Barom. Reduced	Dry Bulb.	Wet Bulb.	Max.	Min.	Rain — inches
1	29,665	51,6	51	56,2	48,6	,11	18	30,379	47	45,5	51,6	42,2	
2	29,877	46,5	45,2	52,2	45		19	30,309	46,5	44,5	56,8	44	
3	30,344	43,8	42	57,4	38		20	30,435	44,5	43	49	41,8	
4	30,515	45,8	44	53,8	42,2		21	30,315	45	42,5	54	41,6	
5	30,484	42,2	41,5	54	37,2	,01	22	30,080	34	32,7	42,6	30,4	
6	30,027	50,2	47	56,2	44		23	29,806	30	28	43,4	24	
7	30,130	46,5	44	56	45	trace	24	29,686	31	29,2	46,2	25	,04
8	30,016	41,2	38	46,2	39	trace	25	29,741	31,5	30,5	43	26,8	trace
9	30,256	35	32	43,8	32	,06	26	30,099	31,5	30,5	49,2	25	,05
10	29,942	44,7	44,2	51,2	38,6	,01	27	29,822	34,5	34	49	32	,25
11	30,253	44,7	44,5	54,4	37,8	,13	28	29,626	31,7	31,5	38	30,4	,02
12	30,283	41,5	38,7	52,6	40		29	29,340	34,5	34	38,8	32	trace
13	30,388	37	33	43	35		30	29,281	30,2	30	42	27	,01
14	30,556	32,2	31	49	28		31	29,525	31,5	30	43,4	27,4	,17
15	30,459	37	35,5	44,2	27,8								
16	30,674	35,5	32,5	43,2	31		Average	30,091					Total
17	30,578	39,5	37	47,2	30								,86

April.

Date	Barom. Re-duced.	Temperature Dry Bulb.	Wet Bulb.	Max.	Min.	Rain — inches	Date	Barom. Re-duced.	Temperature Dry Bulb.	Wet Bulb.	Max.	Min.	Rain — inches
1	29,161	33,5	31	46,6	23	trace	18	29,782	47,6	46	62	42	,04
2	29,223	40,5	37	50,6	33	,01	19	29,689	48	46,8	56,6	44,2	,23
[illegible]	29,548	41,5	39	45,4	33,6	,20	20	29,544	50,6	50	52	44	,49
4	29,764	40	38,7	52,2	30	,03	21	29,614	49,2	46	59,8	42	,05
5	29,853	33,5	33	51,6	30,4	,04	22	29,901	50,6	50	51,6	42	,03
6	30,128	33	31,5	54,2	27,2		23	29,684	48	47,2	54	43	,17
[illegible]	30,213	42	38	55,6	31,6		24	29,595	48,6	47	61,2	43,8	,01
8	30,008	44	40	58,2	35		25	29,852	48,2	[illegible]	59	41	
9	30,028	44,7	40	53	35,4	,01	26	30,085	43,8	40,6	59,6	37,6	
10	29,995	41,5	40,5	51	40,2	,16	27	30,243	46	[illegible]	63,6	39,6	
11	30,010	46,2	44,5	62,2	[illegible]	trace	28	30,206	52	49	64,4	39,8	
12	30,215	42	41,5	62,4	34		29	29,955	52	47,2	66	44	,17
13	30,008	50	46,5	54,4	42,2	,10	30	29,648	49,6	49,2	64,2	46	,01
14	29,986	51,7	50,5	56,2	48	trace							
15	30,004	52	50	63	44,4	trace	Average						Total
16	29,842	48,7	48	56,2	43	,17		29,851					1,99
17	29,718	50,8	48	61,4	43,4	,07							

May.

Date	Barom. Re-duced.	Dry Bulb.	Wet Bulb.	Max.	Min.	Rain — inches	Date	Barom. Re-duced.	Dry Bulb.	Wet Bulb.	Max.	Min.	Rain — inches
1	29,602	57,4	54	64,6	50	,03	18	29,779	63	60	69,4	52	trace
2	29,852	55,4	54	70	46	,01	19	29,782	54,7	50	60	48,4	,07
3	30,004	54,6	54	59,2	48	,40	20	29,841	52,5	49	53,2	45	,21
4	[illegible]9	54	50,2	61,6	40,6		21	29,886	46,5	42,5	53	35	,15
5	[illegible]4	58	52,8	67,2	38		22	29,966	47,5	43,5	56,4	39	,12
6	[illegible]9	54,8	51	68,2	44,6	,12	23	29,483	49	43	60,6	45,4	
7	[illegible]2	57,6	55,2	68	53,2	,78	24	29,290	54,2	50,2	63	46	,42
8	[illegible]3	49	49	55,4	45	,70	25	29,646	51,5	49	63	39,8	,21
9	[illegible]9	48,6	47,4	62,6	44,4	,01	26	29,764	55	51	61	39,6	,05
10	[illegible]9	56	52,4	68	43,4	,10	27	29,779	51,7	48,5	61	45	,20
11	[illegible]6	57,7	53,5	63,2	49	,15	28	29,848	55	51,7	63	41,6	,21
12	[illegible]7	60	55,2	69	46	,25	29	30,037	52	49	59	46,4	
13	[illegible]1	53,5	51,5	61,2	48	,17	30	30,183	47	45	61,2	45	
14	[illegible]4	53,2	50,7	62,8	47	,12	31	30,064	52,5	50,5	65	41	
15	[illegible]0	52,5	51	60,2	49	,04	Average						
16	[illegible]9	54	50,7	63	47,6	,30		29,741					Total
17	29,758	54,2	53	66,2	52	,30							5,12

June.

Date	Barom. Re-duced.	Dry Bulb.	Wet Bulb.	Max.	Min.	Rain — inches	Date	Barom. Re-duced.	Dry Bulb.	Wet Bulb.	Max.	Min.	Rain — inches
1	30,063	50,2	47,7	59,8	45		18	29,922	57	52	67	48,8	,01
2	30,065	54	48,2	57,6	46,4	,45	19	29,972	58,7	55,2	67	51,4	,13
3	29,963	50	49	64,2	46	,28	20	30,072	60	57	71	45,6	
4	29,778	53	52,5	63	51	,02	21	30,110	60,2	56	72,2	48,2	
5	30,072	48	46	56,2	46		22	30,203	63	60	75,6	52	
6	30,234	54,7	50,5	68,2	41		23	30,093	68	64,2	78,4	53,6	
7	30,169	57,5	54	66	50		24	30,075	68,5	65	80,2	59	trace
8	29,800	62	58,2	68,4	52	trace	25	30,178	68,5	64,5	79	62	
9	29,581	58,2	54	61,6	50	,59	26	30,199	73,7	65	85,2	57,2	,99
10	29,688	55,2	51	64,2	49,2	,09	27	30,118	72,7	67,7	84,8	62,2	
11	29,548	53,2	52	61,4	48,2	,12	28	29,969	71,2	66,5	83,2	60,4	
12	29,517	54,5	50,7	61,2	47	,11	29	29,911	63	60	78,2	53	,26
13	29,824	55,2	54	62,2	50	,01	30	29,839	61,2	58	70,2	53,6	
14	29,963	50,2	46,5	58,8	46								
15	29,915	52	47,2	58,6	41,4	,03	Average						Total
16	29,834	54,7	52,2	63	47,4	,06		29,950					3,15
17	29,845	54	51,7	62,4	47								

July.

Date	Barom. Re-duced.	Temperature Dry Bulb.	Wet Bulb.	Max.	Min.	Rain — inches	Date	Barom. Re-duced.	Temperature Dry Bulb.	Wet Bulb.	Max.	Min.	Rain — inches
1	29,963	56,2	53	63,8	54		18	30,368	68,5			55,2	
2	29,896	55	51,2	61,6	47,2		19	30,323	67,5			60	
3	29,938	54,7	52,2	64,8	[illegible]	trace	20	30,195	68,2			58,6	
4	30,139	59	55	68	44,2		21	30,078	69,7			57	
5	30,079	62	60	68	54,4	trace	22	30,081	65,2			57,6	,20
6	29,989	66,5	62	75,4	58		23	30,035	58,4			56,2	,02
7	30,019	63	60	71	54	,01	24	29,759	63			58,2	,68
8	30,097	59,7	56	69	53		25	29,693	59			56,2	,07
9	30,116	61,2	56,5	69	48	,01	26	29,785	58,6			51,6	,01
10	29,931	58	[illegible]	64,2	52,4		27	29,907	58,2			52,4	
11	29,912	56,2	53,7	63,2	53		28	29,978	57,2			48,6	
12	29,924	58,2	54	62,2	52		29	30,050	59,8			52,4	
13	29,992	57,5	54	71	47,4		30	30,207	58,6			47	
14	30,116	57,7	54	68	55		31	30,389	57			52	
15	30,218	60,7	55,2	69,2	52		Average						
16	30,287	61,7	59,5	72	49,4			30,057					Total
17	30,319	64,7	61,5	82,2	52								1,00

August.

Date	Barom. Re-duced.	Temperature Dry Bulb.	Wet Bulb.	Max.	Min.	Rain — inches	Date	Barom. Re-duced.	Temperature Dry Bulb.	Wet Bulb.	Max.	Min.	Rain — inches
1	30,365	54,6	53	68	46		18	3	63,8	60	75,4	54,6	
2	30,080	56	55	74	52	,15	19	2	61	58,2	72	52,4	trace
3	29,791	58,4	57,8	65,4	55,2	,56	20	2	56,4	55	69	49	
4	29,758	57	57	71,8	57	,37	21	3	56,6	52,4	68,2	49,2	
5	29,902	59,6	58,2	72,8	54,6	,18	22	2	60,6	56	69,2	51,4	,65
6	29,791	62,4	61,2	73,2	57,2	,19	23	2	57,4	57	60,4	51,6	,02
7	29,770	63,6	61	73,2	59	,02	24	2	58,6	57,8	69,6	56	,21
8	30,017	64	60	73,4	54	trace	25	2	58,8	58	68,6	56	trace
9	30,145	61,6	57,6	72,2	50	,09	26	2	63	58,2	74,4	50,4	
10	29,708	62	61,2	70,6	58	,08	27	2	61,6	59	71,6	50,6	,21
11	29,418	62	57	71	51	,14	28	2	61	57,6	69,2	54	trace
12	29,527	60	58,8	72,6	56	trace	29	2	61	58	67	52	,20
13	29,633	59	55,2	64,6	53	,74	30	2	56,4	56	68,2	54,8	,10
14	29,318	65,6	59,6	71,4	56,2	,20	31	2	56,4	56	61,2	55	,15
15	29,593	63,6	59,8	70,8	55	,12	Average						
16	29,416	59	57,2	68,4	53,4	,06		2					Total
17	29,817	58,2	53	64,8	47,6								4,44

September.

Date	Barom. Re-duced.	Temperature Dry Bulb.	Wet Bulb.	Max.	Min.	Rain — inches	Date	Barom. Re-duced.	Temperature Dry Bulb.	Wet Bulb.	Max.	Min.	Rain — inches
1	30,008	55,6	54	62,8	50		18	29,652	53	52,8	60,4	46,6	,01
2	30,269	57	53	64	49		19	29,856	51,4	46	58,6	44	,05
3	30,231	60	56,8	71,2	52		20	29,878	46	45	57,6	39	,02
4	30,178	62,2	59	68	51,2	,01	21	30,195	47,4	45	61	39	
5	30,031	[illegible]	59,4	73	56,2	trace	22	29,406	48,4	47,4	56	46,4	,23
6	30,090	59	58,6	73,6	53,8		23	29,875	54	50,4	52,4	40	,06
7	30,149	61,4	59,2	69	52	,96	24	29,638	44,2	43	62,2	32,8	,02
8	30,039	56,4	56	65,4	55,2	,01	25	29,677	50	49,4	57,2	43,2	,25
9	30,025	58,4	56,6	67,4	51	,03	26	29,952	47	45,2	60,4	38	trace
10	30,227	53,4	50,4	70,2	44,6		27	30,064	53	49,8	65,6	48	,02
11	30,283	60,2	57	72,2	46		28	30,089	57,6	56,6	65	50	
12	30,076	59,4	57,2	61	51	,09	29	30,047	57,2	56,4	63,6	53	,16
13	30,158	52,2	50	[illegible]	41,2		30	29,624	52,4	51	58,2	50	,09
14	30,005	53	51	[illegible]	44,6								
15	29,774	56,6	53,2	61,2	54	,15	Average						Total
16	29,680	50	49,8	61	48			29,970					2,37
17	29,942	58,4	55,2	64,4	49	,21							

October.

Date	Barom. Re-duced.	Temperature Dry Bulb.	Wet Bulb.	Max.	Min.	Rain — inches	Date	Barom. Re-duced.	Temperature Dry Bulb.	Wet Bulb.	Max.	Min.	Rain — inches
1	30,043	50	48	55,6	47,6	,04	18	29,952	47	46,7	56	42	
2	30,341	42,6	41	59	33	trace	19	29,789	52,5	50,2	56,6	48,6	,18
3	30,214	53	51,4	66,6	48		20	29,839	50,2	50,2	55	49,2	trace
4	30,169	52,7	51	64	47,4		21	29,600	53,5	52,5	59,2	50	,59
5	30,142	55,5	53,7	73	52	trace	22	29,189	44,7	43	56	43	,02
6	29,807	58	55	66	54	,15	23	29,455	42,2	40,7	54,2	39,2	,28
7	29,577	57,5	56,2	65,2	55,2	,20	24	29,200	46,7	46,5	50	41,8	,38
8	29,335	57,7	57	65	54,2	trace	25	29,194	42,5	41,7	54,9	39,4	,11
9	29,564	54,7	52,5	58,4	50	,20	26	29,009	46	45,7	48,2	43	,02
10	30,146	55	53,2	60	53	,07	27	29,507	38,5	38	53,6	31,6	trace
11	29,793	50,5	47,5	60,2	45	trace	28	29,711	42	40,5	51	37,8	,07
12	30,250	45,2	43,7	61,2	40,2		29	29,823	39,7	37,5	44,6	37	trace
13	30,297	47,2	45	59,2	39,2	trace	30	29,693	34,7	33,5	46	30	,20
14	30,177	46,2	45	61	41	trace	31	29,883	33,7	33,7	40,4	30,4	,10
15	30,032	47,5	47	58,4	40	trace	Average						
16	30,095	51	50,7	53,2	49,6	,03		29,801					Total
17	30,022	43,7	43,7	61,2	42,6	trace							2,64

November.

Date	Barom. Re-duced.	Temperature Dry Bulb.	Wet Bulb.	Max.	Min.	Rain — inches	Date	Barom. Re-duced.	Temperature Dry Bulb.	Wet Bulb.	Max.	Min.	Rain — inches
1	29,994	35	34	47,2	34	trace	18	30,014	41,5	41	46,2	40	trace
2	30,157	34	33,5	46,4	31	trace	19	30,470	32	32	41,2	35	trace
3	30,240	35	34,5	46,2	30,8	trace	20	30,477	30	30	38,4	35	
4	29,954	34,2	34	45	30	,02	21	30,205	31	30,7	37,6	35	
5	29,896	35,7	35	43,2	34	trace	22	30,090	31	29	36,2	35,6	,06
6	29,627	38	34	44	32,4	trace	23	30,022	32	31	36,2	27,2	,51
7	29,720	34,5	33	45,4	33,6	,02	24	29,615	33	33	49,6	31	trace
8	29,441	39	38,5	46,2	31	,05	25	29,331	37,5	37,5	39,4	34	
9	30,160	32,5	31	49	30,4	,40	26	29,515	33,5	33	39	33	,30
10	29,377	49	48,5	48,4	33,6	1,14	27	29,494	32,5	32	39	30,6	
11	29,398	38,5	37,2	45,8	35	trace	28	29,689	38,7	36	40,4	36	trace
12	29,399	31,7	30	39,2	30	,02	29	29,987	28,5	28	39,8	28	,02
13	29,508	35,7	35	41	29,6	,12	30	30,014	32	31,5	36,4	31	
14	29,635	38,2	37,7	42,4	37	,30							
15	29,369	39	38,7	40,2	35,4	,70							Total
16	29,275	39,5	37,7	45	37	trace	Average	29,778					3,84
17	29,275	40	38	44,4	38	,18							

December.

Date	Barom. Re-duced.	Temperature Dry Bulb.	Wet Bulb.	Max.	Min.	Rain — inches	Date	Barom. Re-duced.	Temperature Dry Bulb.	Wet Bulb.	Max.	Min.	Rain — inches
1	29,785	36,2	36	38,4	33	,34	18	29,301	34,6	34	39,6	24	,10*
2	30,022	34,7	34,7	37,4	33,2	trace	19	29,164	33	33	41,2	30,6	
3	30,146	34,5	34	38,6	30,2		20	29,513	29,2	29,2	30,8	28,4	
4	30,207	30,2	30	37,6	29,4	trace	21	29,806	25,2	25,2	33,6	25	
5	30,121	32,7	32,2	42,2	32	trace	22	29,765	31	30	32	25,2	,03*
6	30,113	28,2	26,5	37	27,4	,15	23	29,849	22	22	32,2	21	
7	29,730	33	33	33,4	32	trace	24	30,361	21	21	31,2	11	
8	29,531	29	28	33,6	28		25	30,145	24,6	24,6	32	11,4	,42*
9	29,654	23,6	23,6	34,6	23		26	29,459	32,6	32,6	33,4	30,6	,42
10	29,951	18	18	26	16,4		27	29,461	33	33	36	32	,16
11	29,935	27	27	31,4	24	,04*	28	29,606	36	35,6	41	32	,16
12	29,826	26,4	26,4	26,4	21,2		29	29,479	37,6	37	42	36	,06
13	29,671	27,4	27,4	29,8	20,4		30	29,401	49,6	48	52,4	37,6	,01
14	29,681	21,2	21,2	26,2	19	,01*	31	29,438	50	47,2	52	47	,04
15	29,707	26	26	33,2	22,4	,02*							Total
16	29,520	28	28	31,2	26,6	trace	Average	29,738					1,99
17	29,555	25,8	25,8	31	20	,03*							*snow

Meteorological Section.

The observations have been carried on as usual during the past year, but although the number of observers has been much less than in former years, the observations themselves have been taken and recorded with more than usual accuracy and care.

Last year I had occasion to call attention to a weak point in taking the readings of the thermometers: I am not aware of a single slip in taking these readings during the past year. With the exception of the two months of the summer vacation, I have constantly compared the readings of the School instruments with those taken by myself at my own house, and I have invariably found the results of such comparisons to be quite consistent.

The rainfall for the year was 30.60 inches, more than 7 inches above the average, and nearly 2 inches more than that of last year. The wettest month in the year was May, when 5.12 inches of rain fell, the number of rainy days (*i.e.* days on which .01 inches, or more, of rain fell) being 24.

The heaviest fall of the year, however, took place on the 10th of November, when 1.14 inches of rain were registered.

The following table shews the principal facts connected with the rainfall of each month of the year.

RAINFALL, 1878.

	Total fall.	Greatest fall in 24 hours.	Date.	Number of rainy days.
January	1.77	.53	3	19
February	1.43	.31	27	12
March	.86	.25 (melted snow)	27	11
April	1.99	.49	20	18
May	5.12	.78	7	24
June	3.15	.99	26	14
July	1.00	.68	24	7
August	4.44	.74	13	20
September	2.37	.96	7	17
October	2.64	.59	21	16
November	3.84	1.14	10	14
December	1.99	.42	25 melted snow 26 rain	15
Total fall for the year	30.60		Total number of rainy days	187

The rainfall of 1877 was 28.71 inches.
" " " 1876 " 30.64 "
" " " 1875 " 35.78 "

The average for the 25 years previous to 1875 was about 23 inches.

The following have assisted in the observations during the year.

Mr. Percy Smith. Mr. Kirk (during vacations).
H. St. J. Bashall.
J. H. Dugdale.
W. Ecroyd.
W. Simpson.
W. G. Stutfield.

T. N. HUTCHINSON.

Geological Section.

The number of workers in this section has again been very few, and the work done is therefore less than it might have been. Nevertheless some really good work has been done; some more bones have been found in the glacial drift at King's Newnham by G. Jones and T. B. Oldham, and the cuttings made near Crick for the new railway have given us good opportunities for observing the occurrence, characteristics, and fossils of the Middle Lias; a note on which is attached to this report. But we cannot help regretting that in such a very fossiliferous neighbourhood as Rugby there should have been no competitor for the annual prize for a local collection this year; but, as if to make up for it, a splendid collection is sent us from Cambridge.

List of additional species and localities for this year,

Plesiosaurus megacephalus,	Long Lawford.	
Ammonites armatus densinoclus,	Lower Morton and Railway Cutting, near Crick.	
Ammonites capricornus,	Railway Cutting, near Crick.	
,, obtusus	ditto	ditto
Cardium truncatum,	ditto	ditto
Goniomya rhombifera,	ditto	ditto
Leda rostrata,	ditto	ditto
Ostræa irregularis,	Victoria Works.	
Lima pectinoides,	Railway Cutting, near Crick.	
Serpula sp ,	ditto	ditto
Dentalium sp.,	Hillmorton.	

These fossils were all named by R. Etheridge, Esq., Royal School of Mines, Jermyn Street, for whose generous help the Natural History Society is much indebted. The specimens of Cardium truncatum, Goniomya rhombifera, and Leda rostrata were so fine, that at his request some of them were presented to the Jermyn Street Museum.

Note on the Middle Lias as exposed in Railway Cuttings near Crick, by T. B. Oldham.

In the course of the construction of the new Railway to Northampton and Bletchley many cuttings have had to be made, resulting in the exposure of some fine sections. The rocks thus laid bare are of two distinct kinds; first, and uppermost, is a brown marly and very micaceous sandstone, often conglomeratic in parts; secondly, immediately underlying this come a series of hard light blue shales, also very micaceous, in

which fossils are very abundant and extremely well preserved, some of the shells having even their colour-bands remaining. In the cutting to the east of the high road from Crick to Watford, near to Watford Lodge, the junction of these two beds is very well shewn, and, on reference to the Ordnance Geological Maps, it would seem that the former of these had been taken by the Surveyors as the Marlstone, the latter as the Lower Lias. But in the list of fossils given above, Ammonites capricornus will be found as occurring in these cuttings; and I found this fossil, a characteristically Middle Lias species, not in the brown sandstone but in the blue shales. Therefore it seems that in this case, as in many others, that the physical and lithological boundary does not coincide with the division determined by the evidence of fossils and the succession of life; and that the eras of the brown sandstone and blue shales are not coeval with the eras of the Middle and Lower Lias. This deduction, of course, depends on the Geological horizon at which we draw the line between Middle and Lower Lias; but supposing this to lie, as is now most generally acknowledged, above the zone of Ammonites oxynotus, we must confess that Ammonites capricornus is distinctly a Middle Lias type; that therefore the blue shales as exposed in the cuttings near Crick belong to the Middle Lias, together with the clays dug out at Kilsby, which seem to bo the same beds, and from which, by the kindness of H. N. Hutchinson, O.R., we have in our Museum some very fine fossils, notably Ammonites ibex and Inoceramus dubius; and that the boundary of the Middle Lias as marked on the Survey Maps is palæontologically incorrect.

The following is a list of Tertiary fossils sent us by H. Keeping, Curator of the Woodwardian Museum, Cambridge.

Clyde Drift: Firth of Clyde.

Astarte borealis.
Saxicava rugosa.
Astarte compressa.
Balanus.

Gravel: Barnwell, Cambridge.

Bithynia tentaculata.
Cyrena fluminalis.
Unio littoralis.
Cyclas corneus.

Norwich Crag: Bramerton.

Purpura capillus.
Cardium edule.
Lithornia littorea.

Red Crag: Suffolk.

Trophon antiquum.
gracile.
Buccinum undatum.
Voluta Lamberti.
Columbella sulcata.
Natica.
Trochus Ziziphinus.
Aporrhais pes-pelicani.
Cerithium tricinctum.
Scalaria greenlandica.
Cypraea Europaea.
Fissurella graeca.
Capulus ungaricus.
Trophon costiferum.
scalariforme.
Buccinum Dalei.
Nassa reticosa.
Natica multipunctata.
Purpura tetragona.
Trochus subexcavatus.
Conovulus pyramidalis.
Turritella imbricataria.
Cypraea Avellana.
Calyptraea Chinensis.
Emargenula fissura.
Pecten maximus.
pusio.

Pecten opercularis.
tigrinus.
Mytilus edulis.
Tellina obliqua.
Artemis lentiformis.
(*Walton-on-the-Naze*)
Astarte obliquata.
Cyprina rustica.
Gastrana laminosa.
Pholas crispata.
Balanus crenatus.
concavus.

Cardium Parkinsoni.
(*Walton-on-the-Naze*)
Venus casina.
Tellina crassa.
Pectunculus glycimeris.
(*Walton-on-the-Naze*)
Astarte Bostiratii.
Lucina borealis.
Mactra arcuata.
Mya arenaria.
Charodon megalodon.
hastalis.

Coralline Crag: Orford.

Ostraea edulis.
Cyprina Islandica.
Cardita senilis.
Echinus Lamarchii.
Hornera striata.
Pecten Gerardii.

Diplodonta rotundata.
Terebratula grandis.
Retepora notopachys.
Alveolaria semiovata.
Fascicularia aurantium.

Miocene: Hempstead Beds, Isle of Wight.

Voluta Rathieri.
Cerithium plicatum.
elegans.
Melania inflata.
Cyrena Lyellii.
Corbula vectensis.
Candona Forbesii.
Crocodile, Part of jaw of.
Crocodile, Vertebra of.

Natica labellata.
Rissoa chastelli.
Neritina tristis.
Hydrobia pupa.
Corbula pisum.
Modiola Prestwichii.
Hyopotamus bovinus, Tooth of.
Crocodile, Teeth of.
Coprolite.

Eocene: Bembridge Marls, Isle of Wight.

Cerithium variabile.
Cyrena pulchra.
semistriata.
obtusa.

Melania Forbesii.
turritissima.
muricata.

Eocene: Bembridge Limestone, Isle of Wight.

Bulimus ellipticus.
Planorbis discus.
Helix occlusa.
Egg of Tortoise?

Cyclotus cinctus.
" operculum of.
Helix vectensis.

Eocene: Upper Headon Beds, Isle of Wight.

Limnea longiscata.
fusiformis.
Planorbis euomphalus.
obtusus.
Cytherea incrassata.
Balanus unguiformis.

Paludina orbicularis.
lenta.
Melanopsis subcarinata.
Mytilus affinis.
Cyrena pulchra.
Cyrena obovata.

Eocene: Lower Headon Beds, Isle of Wight.

Unio Solandri.
Chara, Seeds of.

Potamomya plana.

Upper Eocene: Brockenhurst Beds, New Forest, Hants. *(Brockenhurst Railway Cutting.)*

Voluta suturalis.
depauperata.
Cardita deltoidea.
Ancillaria buccinoides.
Ostraea prona.
Psammobia compressa.

Upper Eocene: Barton Beds, Barton.

Rostellaria ampla. (young)
Strombidea Bartonensis. (High Cliff)
Murex ruinax.
asper.
Cancellaria evulsa.
Fusus porrectus.
longaevus. (young)
bulbus.
canaliculatus.
Ancillaria canalifera.
Cominella solandri.
diserta.
Pleurotoma rostrata.
macilenta.
microdonta.
Voluta luctatrix.
ambigua.
scalaris.
Natica ambulacrum.
patula.
Metula juncea.
Mitra parva.
Trochus monolifer.
Eulima polygyra.
Dentalium striatum.
Calyptraea trochiformis.
Pecten carinatus.
Cardita sulcata.
Nucula similis.
Chama squamosa.
Tellina Branderi.
Schizaster D'Urbani.
Vertebra of Fish.
Rimella rimosa.
Terebellum sopitum.
fusiforme.
Typhis pungens.
fistulosus.
Fusus longaevus.
pyrus.
errans.
Cassidaria ambigua. (High Cliff)
Buccinum cavatum.
Conus dormitor.
scabriculus.
Pleurotoma prisca.
turbida.
innexa.
Voluta athleta. (High Cliff)
sub-ambigua.
lima.
Natica epiglottina.
Sigaretus canaliculatus.
Actaeon similis.
Scalaria reticulata.
Solarium plicatum.
Turritella imbricataria.
Phorus agglutinans.
Anomia lineata.
Cardium turgidum.
Pectunculus deletus.
Crassatella sulcata.
Tellina ambigua.
loevis.
Otodus macrotus, Teeth of.

Middle Eocene: Bracklesham Beds, Brook and Bramshaw, New Forest.

Belosepia Blainvillii.
Murex ruinax.
Fusus bulbiformis.
interruptus.
Pseudoliva ovalis.
Strepsidura turgida.
Conus deperditus.
alatus.
Voluta nodosa.
spinosa.
uniplicata.
horrida.
Cerithium trochiforme.
Bonei.
Rostellaria lucida.
Fusus longaevus.
unicarinatus.
polygonus.
Cassidaria coronata.
Triton nodulosus.
Pleurotoma attenuata.
planetica.
dentata.
gentilis.
Natica Willemetii.
ambulacrum.
Cerithium mutabile.
Turritella imbricataria.

Dentalium indeser.
Pecten idoneus.
Corbula pisum.
Phorus umbilicaris.
Arca.
Serpulorbis Moschii.

Bracklesham Beds, Bracklesham.

Bulla Edwardii.
Cardium Edwardsii.
Nucula Dixoni.
Crassatella compressa.
Nummulina variolaria (White Cliff Bay).
Pecten corneus.
Cardita planicosta.
Cytherea trigonula.
Nummulina laevigata.

Bracklesham Beds, Stubbington.

Cerithium cornucopia.
Ancillaria obtusa.
Natica conoides.
Turritella sulcata.
Cytherea laevigata.
Turritella sulcifera.
Mitra labratula.
Voluta Selsiensis.
Cardium Edwardsii.
Pectunculus pulvinatus.

London Clay.

Fusus cymatodis, Clarendon.
  curtus, „
Voluta elevata, Portsmouth.
Natica Hontonensis, Portsmouth.
Pyrula Smithii, Portsmouth.
Cardita Brogniarti, Portsmouth.
Pectunculus decussatus, Highgate.
Pholadomya margaritacea, Alum Bay.
Vermicularia Bognoriensis, Bognor.
Xanthopsis Leachii, I. of Sheppey.
Dromilites Lamarchii, „
Paracyathus caryophyllus, „
Voluta denudata, Bognor.
Voluta nodosa, Highgate.
Aporrhais Sowerbyii, Clarendon Railway Cutting.
Natica Hontonensis, cast of, Portsmouth.
Solarium bistriatum, Portsmouth.
Pectunculus brevirostrum, Bognor.
Panopea intermedia, Alum Bay.
Cytherea orbicularis, Portsmouth.
  subericinoides, „
Ditrupa incrassata, Alum Bay.
Rachiosoma bispinosa, Portsmouth.
Otodus obliquus, I. of Sheppey.
Lamna elegans, „

Woolwich Beds, Woolwich and Dulwich.

Melania inquinata, Woolwich.
Cerithium funatum, „
Cyrena cuneiformis, „
Cyrena tellinella, „
Paludina lenta, Dulwich.
Cyrena cordata, „
  Dulwichiensis, Dulwich.

This excellent and typical tertiary collection was presented to the Rugby School Museum by Prof. T. M'K. Hughes, of Cambridge, and was selected by Mr. H. Keeping. It will be remembered that we lately had the pleasure to present to the Woodwardian Museum two specimens of very great interest: one, the large slab of Cruziana semiplicata, the drawing of which by Mr. Tupper is photographed in our report for 1875, and the other the carboniferous reptile, a species of Telerpeton, figured by Dr. Oldham in the same report.

T. B. Oldham.
Dec. 1878.

Archæological Section.

This Section, though the youngest of all, has had a very successful year, in spite of losing at Easter its first head, H. St. J. H. Bashall (M). His place has been taken by G. Jones (M).

Papers have been read on Archæological subjects by the following: Exploration of a secret chamber at Ardsley, Yorks, M. E. Sadler (M), February 9. Gothic Architecture, as illustrated by the Churches within 4½ miles of Rugby, G. Jones (M), February 23, March 16. Campanology of the above-mentioned Churches, H. J. Elsee (M), at the same two meetings. The School Close, M. H. Bloxam, Esq., F.S.A. (H), March 16. Cross-legged Effigy in a Yorkshire Church, M. E. Sadler, May 18. Excursion of the Section to Brandon, G. Jones, May 18. Excursion to Lilbourne, T. B. Oldham (M), July 6. Druidical Remains in North Wales, H. J. Elsee, November 2. Remains near Blundeston, Suffolk, C. E. Sayle (A), November 2. Tripontium (2), G. Jones, December 7. It will thus be seen that the members of this Section have in the year read 10 papers. Numerous exhibitions have been made by the Section, most of which are in the Museum.

The 44 churches within 7 miles of Rugby have all been visited, and arranged in architectural order. It is hoped that during the coming summer (1879) full notes and drawings will be made on all of them, and placed in the Society's Library. The bells of these churches are receiving very careful attention at the hands of H. J. Elsee, and will be described with the churches.

Caves Inn and Long Lawford Lime-pit have been regularly visited. Great quantities of pottery and bones have been obtained from the former place, but only a few incoherent fragments of coarse pottery from the latter.

Nothing has been attempted at the ancient Anglo-Saxon town of Cestersover; nor has Princethorpe been visited. It is to be feared that not much would be gained by the most careful search at either place. Still they are both worth recommending to the care of the Section.

Some good Samian ware with patterns, and a mortarium with a name stamped on it, have been found at Caves Inn. Interesting encaustic tiles, and a monumental slab of the 14th century, have been found at the Parish Church during the restoration. It is said that the workmen found at one time fragments of tracery during the excavations, but said nothing about it, broke them up, and threw them into the foundations. It is also to be feared that a curious window which appears to have been pierced right through the eastern wall of the tower of the church, above the vaulting springers, should have been blocked by a monument. Nothing else has been discovered in the neighbourhood during the year. No churches are now being restored—a matter for great rejoicing.

Three excursions were made by the Society. 1. On Saturday, May 25, to Brandon Castle, Wolston, Ryton, Bubbenhall, and Stoneleigh Churches. Two old bridges were inspected near Stoneleigh. Thence by Stoneleigh Abbey the party made their way to Kenilworth Station. 2. To Lilbourne Castle, Lilbourne, Catthorpe, Shawell, and Clifton Churches, and Caves Inn. Both these were accompanied by the Rev. T. N. Hutchinson. 3. To Kenilworth Castle, visiting the Cross on Knightlow Hill. On this occasion a party of 22 was made up, and drove to the Castle. It was accompanied by Mr. Moberly, Mr. Cumming, and Mr. Bloxam.

The thanks of the Section are due to all who have assisted it, and especially Mr. Bloxam, whose kindness as usual has never failed.

G. JONES (M), Head of Section.
C. E. SAYLE (M).

Entomological Section.

We are glad to state that there has been a slight improvement in the work of this Section for 1878: the observation list is longer than last year, but we think that more might be done with a very little trouble: the gaps in the collection have been partially filled up, and some good additions have been made.

The following is the observation list of insects noticed at Rugby, compared with the record of the previous year.

The observers are thus designated:—A. Sidgwick, A.S.; H. V. Weisse, H.V.W.; J. Lea, J.L.; G. S. Napier, G.S.N.; E. Solly, E.S.

Observer.	Name.	1878.	1877.
J. L.	H. Rupicapraria	Feb. 11	—
"	H. Progemmaria	" 12	—
H. V. W.	G. Rhamni	Mar. 3	—
J. L.	A. Polydactyla	" 3	June 11
"	P. Rapae	April 12	—
"	V. Urticae	" 12	—
G. S. N.	S. Megaera	" 15	—
J. L.	P. Napi	May 8	—
"	A. Cardamines	" 8	June 9
A. S.	H. Abruptaria	" 9	—
E. S.	P. Brassicae	" 9	—
H. V. W.	M. Rivata	" 10	—
A. S.	E. Ministrana	" 18	—
"	L. Marginata	" 18	June 23
"	E. Punctaria	" 18	July 7
"	C. Punctata	" 18	—
"	A. Viridella	" 18	—
"	P. Tripunctana	" 18	—
"	V. Cardui	" 18	June 11
J. L.	S. Certata	" 18	—
"	M. Fluctuata	" 18	June 11
"	M. Montanata	" 18	" 9
"	C. Ferrugata	" 18	" 9
A. S.	P. Bucephala	" 29	" 30
"	A. Lubricipeda	" 30	Sept. 22
G. S. N.	C. Phloeas	" 30	June 24
A. S.	A. Menthastri	" 31	" 11
E. S.	P. Gamma	June 2	" 9
"	M. Brassicae	" 2	" 9
J. L.	P. Falcataria	" 8	—
"	F. Piniaria	" 8	—
"	C. Silaceata	" 8	—
"	A. Selene	" 8	—
"	L. Lactearia	" 8	June 26
"	H. Arbuti	" 8	—

Observer.	Name.			1878.		1877.
G. S. N.	C. Exanthemaria	...	...	June 8	...	—
"	H. Humuli	...	...	" 10	...	June 26
E. S.	S. Tiliae ...	...	...	" 11	...	" 21
J. L.	M. Stellatarum	...	...	" 13	...	—
G. S. N.	C. Bilineata	...	...	" 13	...	June 23
H. V. W.	M. Palpina	...	...	" 18	...	—
G. S. N.	H. Nymphaeata	...	...	" 18	...	—
"	H. Proboscidalis	...	...	" 18	...	—
"	C. Lemnalis	...	...	" 20	...	—
J. L.	H. Sylvanus	...	...	" 22	...	—
"	B. Repandata	...	...	" 22	...	—
"	E. Valerianata	...	...	" 22	...	—
"	A. Luteata	...	...	" 22	...	—
"	T. Viridana	...	...	" 22	...	July 4
"	M. Salicalis	...	...	" 22	...	—
"	E. Ambigualis	...	...	" 22	...	—
G. S. N.	M. Albicillata	...	...	" 22	...	—
"	M. Subtristata	...	...	" 22	...	June 4
"	H. Linea ...	...	...	" 22	...	—
"	C. Pusaria ...	...	...	" 22	...	June 23
E. S.	C. Pamphilus	...	...	" 23	...	—
"	L. Alexis ...	...	...	" 23	...	June 18
"	A. Filipendulae	...	...	" 24	...	—
J. L.	T. Pronuba ...	...	...	" 24	...	—
"	A. Psi ...	...	...	" 27	...	July 11
"	M. Persicariae	...	...	" 28	...	June 12
"	L. Sorbiana	...	...	" 28	...	—
"	X. Polyodon	...	...	" 29	...	July 3
E. S.	H. Janira ...	...	...	" 29	...	June 30
A. S.	P. Iota ...	...	...	July 1	...	—
"	H. Tarsipennalis	...	...	" 1	...	—
E. S.	B. Rhomboidaria	...	...	" 1	...	—
J. L.	B. Perla ...	...	...	" 3	...	July 13
E. S.	L. Lithargyria	...	...	" 3	...	—
"	T. Orbona ...	...	...	" 3	...	—
"	C. Populata	...	...	" 4	...	—
"	T. Amataria	...	...	" 4	...	July 7
"	M. Margaritaria	...	...	" 4	...	July 18
"	O. Potatoria	...	...	" 4	...	—
"	A. Exclamationis	...	...	" 4	...	July 3
"	A. Oculea ...	...	...	" 4	...	July 12
J. L.	C. Cubicularis	...	...	" 5	...	July 24
G. S. N.	E. Mensuraria	...	...	" 5	...	—
"	A. Aversata	...	...	" 6	...	July 4
J. L.	M. Oleracea	...	...	" 6	...	—
"	L. Salicis ...	...	...	" 8	...	July 23
G. S. N.	C. Dotata ...	...	...	" 8	...	—
"	C. Perlellus	...	...	" 9	...	—
"	S. Prunalis	...	...	" 9	...	—
"	S. Olivalis ...	...	...	" 9	...	July 2
"	C. Fulvata ...	...	...	" 9	...	July 12
"	S. Tithonus	...	...	" 9	...	July 18
E. S.	H. Nictitans	...	...	" 12	...	—
J. L.	C. Caja ...	...	...	" 13	...	—
E. S.	B. Roboraria	...	...	" 13	...	—
J. L.	A. Grossulariata	...	...	" 14	...	July 19
G. S. N.	T. Cloacella	...	...	" 15	...	—
"	N. Augur ...	...	...	" 15	...	—

Observer.	Name.	1878.	1877.
E. S.	H. Wavaria	July 15 ...	—
G. S. N.	C. Culmellus	„ 16 ...	—
„	C. Pratellus	„ 16 ...	—
„	M. Institialis	„ 16 ...	—
„	H. Thymiaria	„ 16 ...	July 12
„	A. Bisetata	„ 16 ...	—
J. L.	C. Pyralata	„ 17 ...	July 12
E. S.	C. Dotata	„ 17 ...	—
„	Z. Aesculi	„ 18 ...	—
G. S. N.	L. Auriflua	„ 18 ...	—
H. V. W.	Y. Elutata	„ 20 ...	Oct. 2
„	M. Unangulata	„ 20 ...	July 18
J. L.	C. Trapezina	„ 21 ...	—
G. S. N.	H. Potamogata	„ 21 ...	—
„	A. Imitaria	„ 21 ...	July 18
E. S.	I. Interjecta	„ 21 ...	—
J. L.	M. Maura	„ 26 ...	—
G. S. N.	C. Tristellus	„ 27 ...	—
J. L.	P. Gamma	Sept. 28 ...	—
„	G. Libatrix	Oct. 1 ...	Oct. 1
„	O. Antiqua	„ 4 ...	Oct. 14
E. S.	G. Rhamni	„ 5 ...	—
J. L.	P. Rapae	„ 5 ...	—
„	C. Miata	„ 5 ...	—
„	P. Chrysitis	„ 5 ...	—
„	C. Brumata...	Nov. 14 ...	Nov. 12
A. S.	P. Meticulosa	„ 16 ...	„ 14

We also subjoin a List of Rugby Insects that have been bred:

A. S.	E. Lucipara	J. L.	T. Instabilis (2)
„	A. Betularia	E. S.	S. Populi
„	N. Camelina	„	C. Caja
„	S. Populi	„	B. Neustria
J. L.	S. Tiliae	„	O. Potatoria
„	S. Populi (2)	„	D. Vinula
„	H. Progemmaria	„	M. Persicariae
„	T. Gothica	„	C. Trapezina
„	T. Stabilis (8)		

The following is a List of Insects presented to the collection: those marked (†) are new species.

Given by J. Lea.

H. Rupicapraria (2)†
E. Abbreviata†
M. Rivata (2)†
M. Fluctuata (2)†
C. Miata (3)†
C. Suffumata (4)†
A. Fumata
C. Unidentata
A. Badiata (4)†
A. Derivata (4)†
S. Dubitata (3)
C. Obliquaria†
A. Nebulosa
C. Umbratica
H. W-Latinum (2)
T. Munda (2)†
X. Rhizolitha
G. Trilinea (3)
H. Dentina (3)†
A. Segetum (3)†
M. Anceps
M. Basilinea (3)
X. Petrificata (2)†
X. Aurago (2)†
X. Cerago (2)
X. Hepatica (2)

Given by A. Sidgwick.

Oenistis Quadra (2)†
Pieris Daplidice (foreign)
Corycia Punctata (2)†
B. Betularia (black)

Oleracea†
Nemophora Schwarziella†
Adela Viridella†
Pardia Tripunctana†

Given by E. Solly.

Clisiocampa Neustria (2)
Cilix Spinula (3)

Gortyna Flavago
Hydroecia Micacea
Luperina Testacea (2)
Miana Literosa (3)
Xanthia Gilvago†
„ Ferruginea
Dianthoecia Albimacula†
Cosmia Trapezina†

Coremia Propugna (3)†
Melanthia Rubiginata (2)
Thera Variata (1)
„ Firmata (1)

Given by Mr. Watkins.

Rumia Crataegata (strange variety)

A. SIDGWICK.
E. SOLLY.

Zoological Section.

[The Zoological Section is in abeyance: but we print the following notes which belong to this head.]

"In May, last year, I was introduced by the friends with whom I am staying to a small kitten, a month or so old, which they had just begged from a neighbour on account of its curious colour. It was a *whole grey* with no markings: the same all over, except its paws and shirt-front, which were white. The kitten promptly received the appropriate name of Grizzel (varied to Griselda on Sundays). Now, February, 1878, coming again to the same house, I asked, "And how is Grizzel?" "Well," was the answer, "the most extraordinary thing has happened; she has turned black." I could scarcely believe it: but there she was, without a doubt, sitting on the kitchen table—a glossy jet-black cat, with white feet and shirt-front shining by contrast. The miller happened to be in the kitchen, and knowing how cats haunt mills, I asked him if he had ever known such a thing before. He said he had once: a "rat-coloured" kitten (by no means a bad description of Grizzel's original tint) *had* turned black within his knowledge.

"E. G. W."

"Last holidays an instance of extraordinary rapacity, displayed by a hen, came to my notice. Ten pheasants' eggs had been placed under a hen; everything went well until the pheasants were about a week old, then one pheasant disappeared every day. No one could guess the meaning of it until one day the hen, not having breakfasted early enough, was found finishing her meal upon an unfortunate pheasant. This had occurred eight times, for two alone were left. I never heard of this occurring before, and therefore thought that it might be as interesting to the Society as to me."

"By the road-side, before a small village post office, I saw a large retriever dog and a goat at play: their *modus operandi* was as follows. The dog was on the attacking and the goat on the defensive side; the

dog jumping up at the goat, and the goat parrying his attacks with her horns, which the dog took into his mouth and knawed at. They continued this for a long time, and were in the habit of constantly playing in the same way; for, on examining the horns of the goat, I found them very much worn by the dog's teeth. I learnt that they had been brought up from very young together, so that accounted in a great measure for their intimacy. I think one may trace the natural instincts of both animals in their way of playing: everyone knows the dog's love of a bone: in this case the horns of the goat supplied the bone: and the goat also, from its natural instinct, enjoyed butting at the dog: it probably considered it good practice, in case occasion for using its horns for more serious purposes should present itself. The noticeable thing, however, was that they each took care not to hurt the other; for the goat always managed to miss the dog with the end of its horns, though perhaps we must give the dog some credit for that."

Rook's nests in Close, counted on April 20, 1878, and April 17, 1879, by A. Sidgwick. The numbers refer to the trees in the plan, Report for 1876, plate 7.

1878.	Tree 3	had	6	nests.
	„ 4	„	13	„
	„ 5	„	17	„
	„ 6	„	4	„
	„ 7	„	4	„
	„ 10	„	1	„
	„ 12	„	4	„
	„ 13	„	1	„
	„ 14	„	11	„
	„ 15	„	8	„
	„ 16	„	10	„
	„ 36	„	3	„
	„ 39	„	1	„
	„ 40	„	1	„
	„ 41	„	2	„
	„ 45	„	2	„
	„ 46	„	2	„
	On the Island		3	„
	Total	.	93	nests.

1879.	Tree 3	had	3	nests.
	„ 4	„	10	„
	„ 5	„	12	„
	„ 6	„	2	„
	„ 7	„	3	„
	„ 8	„	2	„
	„ 10	„	[fallen]	
	„ 11	„	3	„
	„ 14	„	10	„
	„ 15	„	6	„
	„ 16	„	5	„
	„ 36	„	1	„
	„ 45	„	3	„
	„ 46	„	3	„
	On the Island		1	„
	„ 48	„	1	„
	Total	.	65	nests.

A. S.

[We print the following, as a pleasant record of a pleasant day. See p. 22.]

"The members of the U.S.N.H.S., in acknowledging the kindly communication of the R.S.N.H.S., beg to offer their warmest thanks to Mr. Sidgwick and the other members of the R.S.N.H.S., whose friendliness and energy made the late joint expedition such a pleasant success.

They wish, at the same time, to convey their thanks to Mr. Gillson for his kindness to them. And, finally, they desire to express a hearty hope that the two Schools and the two Societies may soon improve the friendship they trust has thus been started.

"For the U.S.N.H.S.,

"EDWARD THRING, *President.*
SAM. HASLAM, *Vice-President.*
ERNEST POWER, *Secretary.*"

Botanical Section.

Our Report this year is but very short and contains, we are sorry to say, the record of very little work. There have been practically not more than two observers; others who were making private collections not having supplied materials as to dates of flowering of the plants they obtained: in consequence only about a hundred and fifty plants have been recorded in flower. This is specially to be regretted, and perhaps needs only naming to be remedied in the case of future workers. The following additions have been made to our knowledge of local flora, again largely owing to the continued kindness and support of H. W. Trott, Esq., (O.R.) to whom we wish to tender our best thanks.

Scolopendrium vulgare. One specimen on the road between Little Lawford and King's Newnham, in a ditch nearly opposite a small cottage, half-a-mile from Little Lawford. (H. W. T.) Also in a ditch about half-a-mile on the Rugby side of Barby. (H. Johnson, Esq. O.R.)

Asplenium Trichomanes. Has entirely disappeared from its single former locality in Newbold Tunnel, between April and July of last year. (H. W. T.)

Reseda luteola. Also disappeared from former locality near Little Lawford. (H. W. T.)

Bromus erectus. Canal bank at Newbold-on-Avon. New plant. (H. W. T.)

Ophrys apifera. In abundance in Newbold Lime Works in a disused pit. (R. G. Boyce and G. Hutchinson.) Also on the canal bank between Newbold Tunnel and the bridge over the Harboro' Road. It has quite disappeared from the canal bank between Clifton and Hillmorton, where it was plentiful in 1877. (L. C.)

Orchis pyramidalis. Single specimen on the canal bank close to Newbold Tunnel. (L. C.)

Festuca sciuroides. In abundance in Mr. Pinfold's Clay Pits, beside the footpath to Lawford. New locality. (H. W. T.)

Lepidium campestre. Cornfield between Little Lawford and Cathiron Lane. New locality. (H. W. T.)

Carex pendula. }
Potamogeton pusillus. } Near the old canal at Brownsover. New locality. (A. Boughton Leigh, Esq.)

Scirpus setacea. Recovered to the list: beside a large pond on the right-hand side of Blue Boar Lane, going from Long Lawford. (H. W. T.)

Ranunculus Lenormandi. Small pond beside the Blue Boar Lane going from Lawford. New plant. (L. C.)

Hieracium boreale. Recovered to list: lane between Cawston Toll-bar and Blue Boar Lane. (L. C.) Also on roadside a little before Dunchurch Toll-bar. (H. W. T.)

Silene noctiflora. Recovered to list: cornfield by Blue Boar Lane. (L. C.)

Sparganium simplex. Small pond beside Blue Boar Lane, together with *R. Lenormandi.* New locality. (L. C.)

Holcus mollis. Almost overlooked hitherto: common everywhere, flowering in July after *H. lanatus* is past. (H. W. T.)

Œnanthe fluviatilis. New plant to the district: in the river beside the footpath to Brownsover. (H. W. T.)

Brachypodium pinnatum. Roadside between Birdingbury and the Wharf, about ¾ mile from the village, growing with *B. sylvaticum*, from which it is distinguished by its shorter awns. (H. W. T.)

Scabiosa columbariæ. New plant.
Carduus acaulis. New locality.
Picris hieracioides. New locality.
} Abundant in a meadow on right of road between Birdingbury and the Wharf. (H.W.T.)

Asplenium Ruta-muraria. On the wall of the park at Watford. New locality. (L. C.)

H. W. Trott, Esq., also sends us the following notes on plants of interest, found by him somewhat outside the seven mile radius:—

Limanthenum nymphæoides. Naturalized in a pond at Welton Park, near Daventry.

Ranunculus Lingua. Same locality.

Nymphæa Alba. Same locality.

Lotus tenuis. Abundant between Birdingbury and Napton.

Alisma lanceolata. Canal between Birdingbury Wharf and Napton Reservoir.

Rumex viridis. Canal side at Napton.

Polygonum terrestre.
Helminthia echioides.
Juncus compressus.
} Beside Napton Reservoir.

Centaurea scabiosa. Napton Hill.

Stachys palustris. Napton Hill, abundant in cornfield. Apparently a curious hybrid form between *S. palustre* and *sylvatica*: very like *S. palustris*, but differs in having a shorter raceme and smaller flowers, as also in its habitat—a dry cornfield.

The November list was carefully worked by one observer only, who however found some 50 or 60 plants in flower. It is much to be regretted that the list has been mislaid. If found, it will, we hope, appear in a future Report. Some progress has been made in arranging the local collection, in which we have been helped by Sayle, and we hope this year to make up a list of the specimens actually in our possession, with a view to filling up some of the numerous gaps (many among the commonest plants) during the next summer.

The following presentations have been made to the Society's Herbarium.

Cephalanthera rubra. Two specimens from the only locality at Pitchcomb in Gloucestershire, given by H. C. Reader, (O.R.)

A collection of about 25 plants, mostly Cornish and Scotch, from the Northamptonshire Naturalist's Society.

Papers of interest read during the year will be found in the preceding portion of the Report.

L. CUMMING.
R. CORDINER.

P.S.—In last year's Report, p. 60, ll. 27—29, the locality "in a cornfield beside the footpath to Newbold, on the left of the path after crossing the Leamington line," belongs to *F. sciurioides*, and not to *F. sylvatica* as stated.

H. W. T.

Description of the Plates.

Plates 1 and 2: Drawings on stone, by Rev. T. N. Hutchinson, to illustrate a paper by him on Ice-borne Boulders in Yorkshire. See p. 25.

Plate 3: Drawings of esculent fungi, to illustrate paper by A. Percy Smith on that subject. Drawn by the author. See p. 6.

Plate 4: Drawings of insects, by F. T. Arnold, to illustrate a paper on Insect Transformations, by A. Sidgwick. See p. 15.

Plate 5: Drawing, by H. C. Clifford, of Mr. Cumming's dissections of a monstrous specimen of Campanula. See Plate 7, and p. 33.

Plate 6: Imaginary sketch of the First and Last Dodo, by an anonymous artist. Papyrographed by A. Sidgwick. See p. 34.

Plate 7: Drawing by H. C. Clifford of the monstrous Campanula. See Plate 5, and p. 33.

Plate 8: Drawing by T. B. Oldham of the Toft Pits, to illustrate his paper on the Geology of Rugby. See p. 45.

Note.—On p. 45, line 21, *for* (Plate .) *read* (Plate 8.)

A. J. Lawrence, (late W. Billington), Printer, Rugby.

Ice-borne Boulders on "Norber," near Clapham, Yorkshire

PLATE I

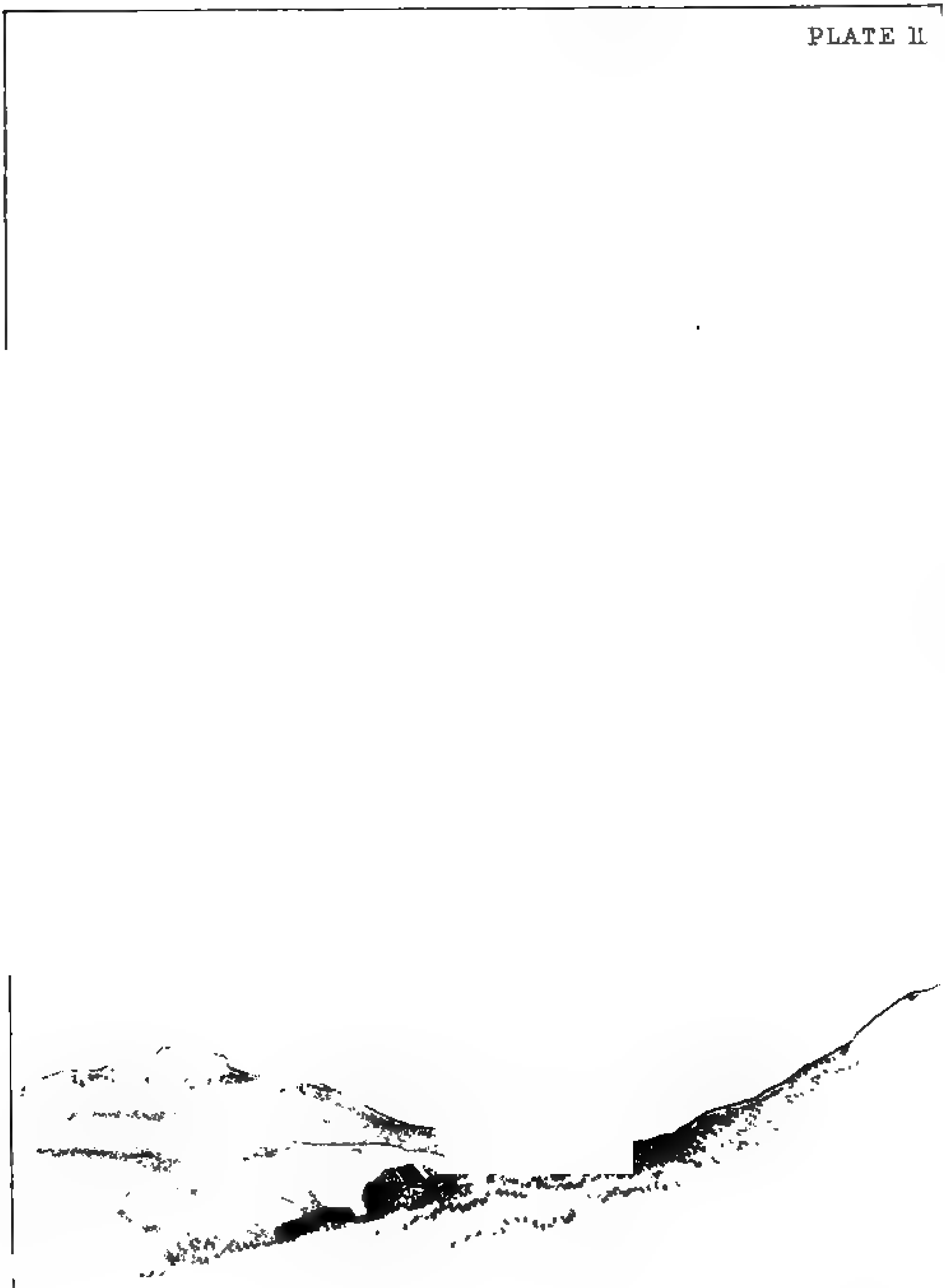
1.

2

3.

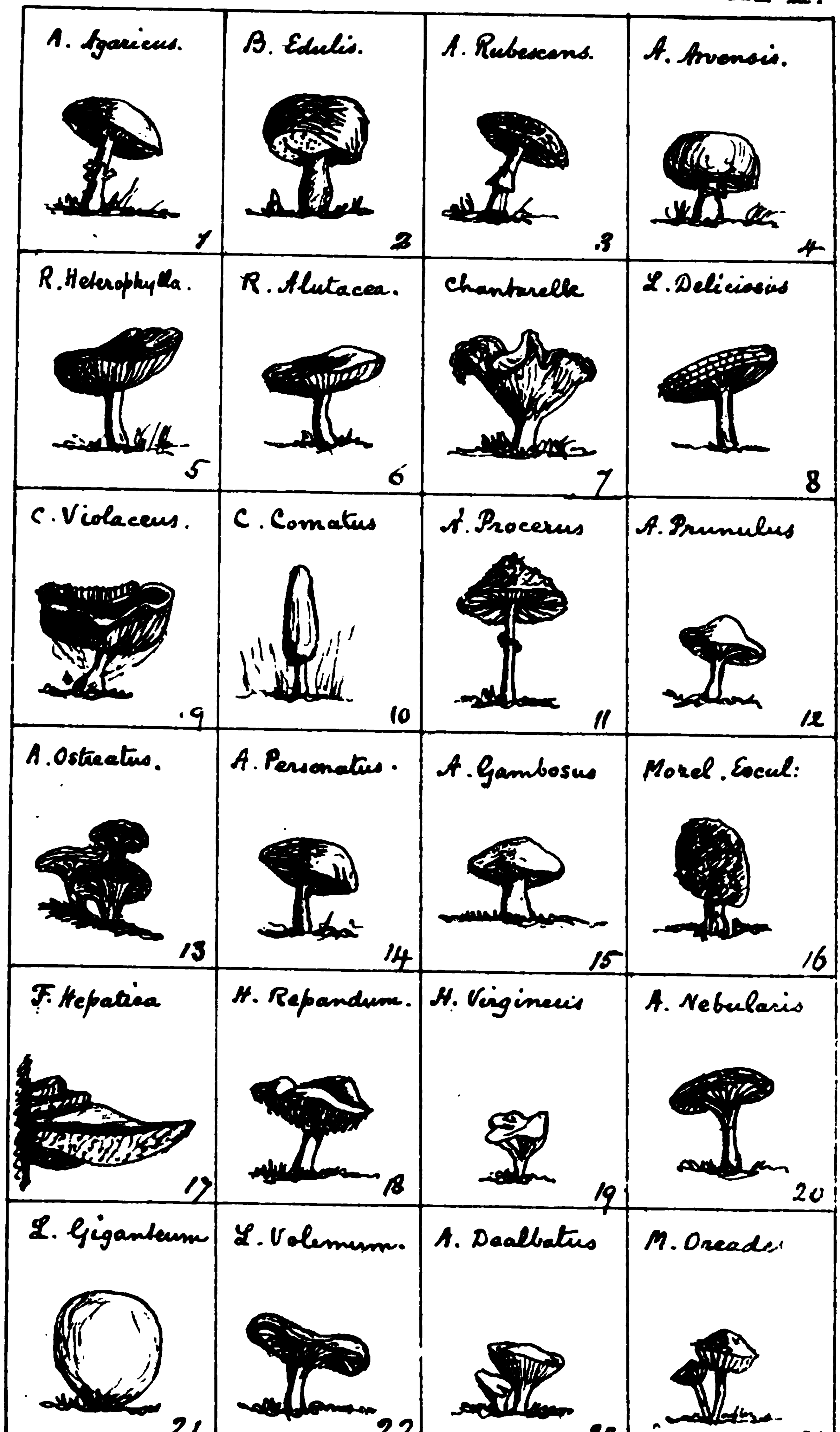
6

PLATE II



"Erratic" on Winskill Scar, near Settle.

PLATE III.



A Percy Smith.

Cowell's Anastatic Press
Ipswich.

Plate 4.

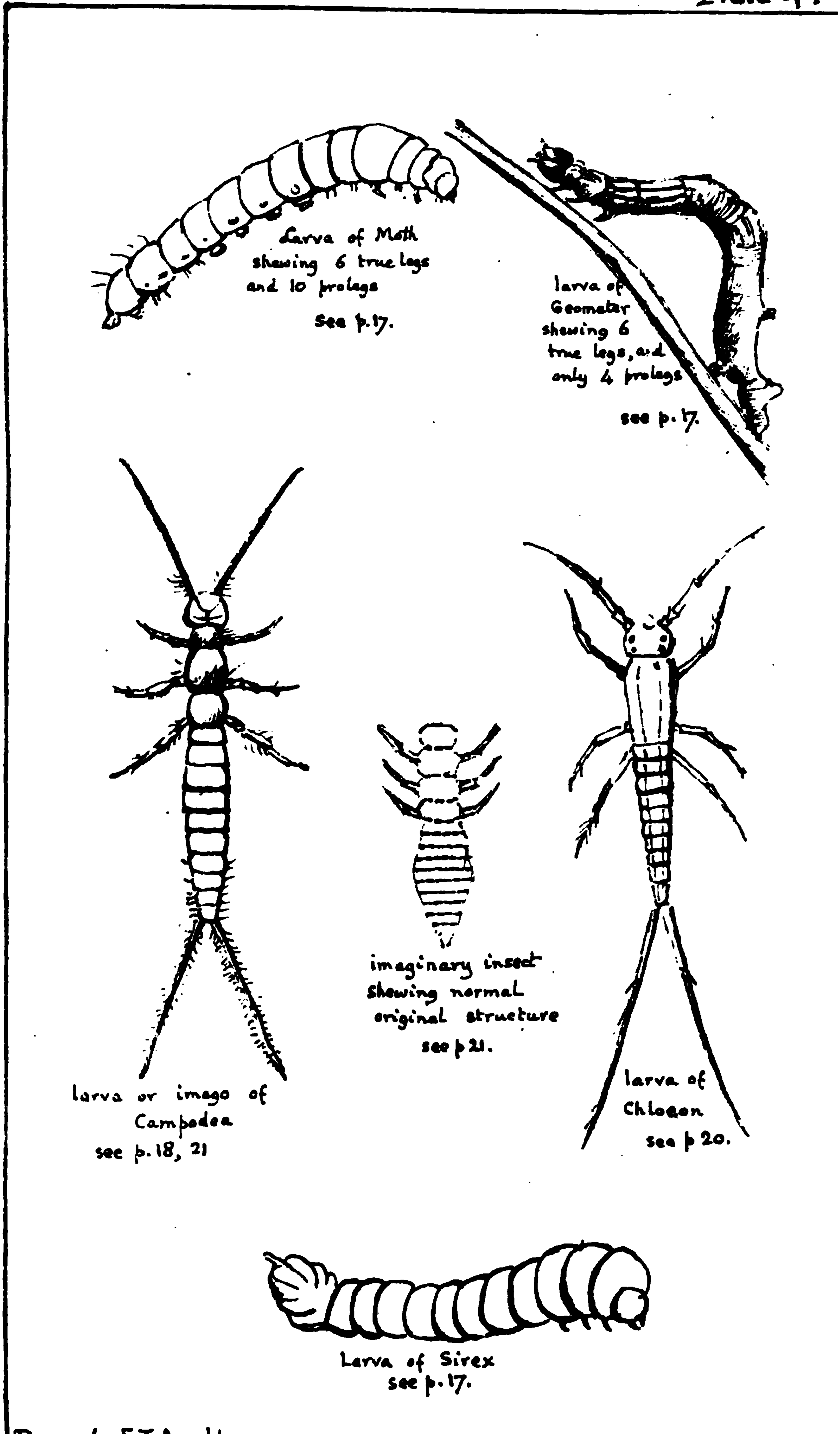


Plate to illustrate Paper on Insect Transformations, by A. Sidgwick, Page 1[illegible]

Plate 5

Plate 6

The first Dodo

The last

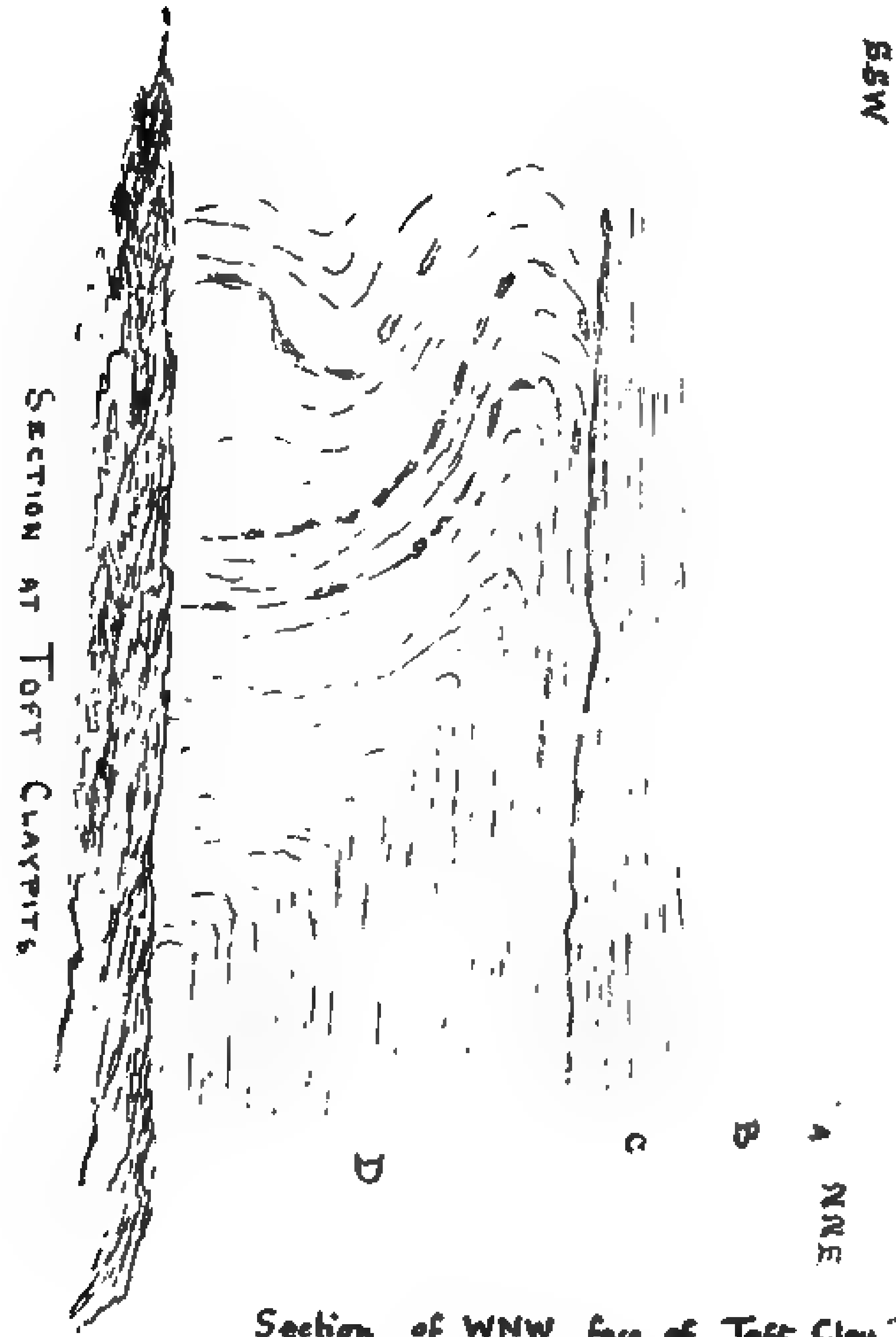
Plate 7

Drawing of a monstrous specimen of Campanula: see page 33

Drawn by H. C. Clifford, copied from a sketch of his own made at the time from Nat

Plate 8

Drawn by T. B. Oldham, to illustrate his paper on the Geology of Rugby



Section of WNW face of Toft Clay Pits
Aug. 1878

A... surface soil ... 6 inches

B.. Quartzose Northern Drift .... 2 feet

C... Blue glacial Clay Drift ... 2 feet 6 inches

D... Contorted lower Lias Shales, with layers of yellow Nodules

Report on the Temple Observatory,

FOR THE YEAR 1878.

The principal work done in the Observatory during the year 1878 has been, as in previous years, the measurement of position and distance of double stars. The number of stars so measured by Mr. Wilson, Mr. Percy Smith, and myself, is 65: a number somewhat less than that of prevous years, owing in a great measure to the fact that the attendance of members of the School and the time given to them has, I am glad to say, very considerably increased since the Observatory has been built on its present site. The measurements are chiefly of stars contained in a list made by Mr. Wilson of well ascertained binaries.

I have given further attention to the measurement of the motion of recession or approach of stars to or from the earth with the large Spectroscope on the Reflector, and have taken measures of 23 stars; but the available evenings have been few.

The Clocks have been corrected by transits taken every available night by members of the School, Mr. Percy Smith and myself, and true Greenwich time has been always obtainable at the Observatory.

The errors of the Transit have been properly found and adjustants made. Its foundation appears to have taken its final settlement, as the errors are now comparatively very small to what they were at the commencement of the year. W. E. Home, from the reduction of a number of transits, has determined very accurately the values of the distance between the transit wires for reducing the observations to the mean wire.

Home has also graphically represented on millimètre paper, the positions at the different dates at which they have been observed of 27 well known binaries from the observations of the different observers, with a view to the calculation of the orbits of the same, —a work of considerable labour and of permanent value for use in the Observatory.

The Buildings are in good order, as also are the instruments, which are practically in the same state as when I reported last, with the exception that a Barlow lens has been added to the Equatorial, and has been carefully adjusted so that each second in the diameter of an object corresponds, with a very slight correction, to 10 divisions of the micrometer, which is almost equivalent to doubling the original size before the addition of the lens. By this addition it is expected that the measures of position and distance will be more accurate and will require less time for reduction.

The Observatory has been open to members of the School for an hour every fine evening; during the months of January and February, from 5.30 to 6.30 on Tuesdays, Thursdays, and Saturdays, and from 6 to 7 on other days; during March, from 6.30 to 7.30; during April, from 7.30 to 8.30; during May, from 8.30 to 9.30; during June and July, from 9 to 9.30; and after the Midsummer holidays, from 6.30 to 7.30 for the remainder of the year.

Mr. Percy Smith and I have instructed those who happened to be present in some of the most elementary subjects of Practical Astronomy as they suggest themselves at the time; any settled course of instruction being impossible by reason of the constant change in the attendance. There have, however, been a few who attended regularly, and have gone on with the subject systematically; and some of these I have instructed in the use of the Sextant and Theodolite for an additional hour on one half-holiday in the week. Amongst those who have given most attention I may mention Home, Landor, Downing, T. B. Oldham, and H. Y. Oldham,

The number of names of Visitors entered in the Note Book is 352.

The Observatory is indebted for the following Donations:

Micrometrical measures of Double Stars ...	George Knott, Esq.
Report on preparation, &c., for Transit Venus	Col. Tenant.
Gregorian Telescope	Rev. T. N. Hutchinson.
Second Part of work on Binaries, in proof, Edinburgh Astron. Obs. Vol. 14 ...	The Astronomer Royal of Scotland.
Publication of Cincinatti Observatory ...	Ormond Stone.
"Recherchés sur la Réfraction Astronomique," with tables of refraction. Also a copy of Paper from Academ. Sciences, St. Petersburgh, (3 papers)	M. Kowalski.

Ast. Obs., Leyton Observatory ...	...	BARCLAY.
Mem. Ast. Soc. Vol. 43 ...	...	J. M. WILSON.
Triangulation of Java (1875) ...	...	DR. OLDHAM.
Ast. Obs. of Leyton Observatory	...	J. G. BARCLAY.
Ephemeides of Sat. of Mars ...	...	A. HALL.

I am extremely sorry to lose the assistance of Mr. Wilson, both in the direction of the course of work and carrying on the work itself. He has, however, established a line of study here which it will not be difficult to follow, and I hope, with the assistance of Mr. Percy Smith, the Observatory will keep up the reputation for double star measurements which it has so rapidly earned.

GEO. M. SEABROKE,

HON. CURATOR.

A. J. LAWRENCE, (LATE W. BILLINGTON), PRINTER, RUGBY.